

**DRAFT REMEDIAL INVESTIGATION REPORT
OMEGA CHEMICAL CORPORATION SUPERFUND SITE OPERABLE UNIT 2
LOS ANGELES COUNTY, CALIFORNIA
VOLUME 1**

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Prepared for
U.S. Environmental Protection Agency
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San Francisco, California 94105

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March 2009

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Acronyms

°C	degrees Celsius
µg/L	micrograms per liter
µg/m ³	micrograms per cubic meter
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
1,1,2-TCA	1,1,2-trichloroethane
1,2,3-TCP	1,2,3-trichloropropane
1,2-DCA	1,2-dichloroethane
1,2-DCE	1,2-dichloroethene
1,3-DCP	1,3-dichloropropane
AIS	American Integrated Services
AMK	Angeles and McKesson
APCL	Applied P and CH Laboratory
ARAR	applicable or relevant and appropriate requirements
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
atm-m ³ /M	atmospheric-cubic meter per mole
bgs	below ground surface
BOD	biochemical oxygen demand
BTEX	benzene, toluene, ethylbenzene, xylene
CADRE	Computer-Aided Data Review and Evaluation
Cal-EPA	California Environmental Protection Agency
Caltrans	California Department of Transportation
Calvada	Calvada Surveyors, Inc.
CAM	California Assessment Manual
CD	Consent Decree

CDPHS	California Department of Public Health Services
CDM	Camp, Dresser & McKee
CDWR	California Department of Water Resources
CENCO	CENCO Oil Company
CERCLA	Comprehensive Environmental Response Comprehensive and Liability Act of 1980
cis-1,2-DCE	cis-1-2-dichloroethene
cis-1,3-DCP	cis-1,3-dichloropropene
CLP	Contract Laboratory Program
cm/sec	centimeters per second
COC	chain-of-custody
COD	chemical oxygen demand
COPC	chemical of potential concern
CPT	cone penetrometer test
Cr(VI)	hexavalent chromium
CSM	conceptual site model
d	day
Datachem	Datachem Laboratories, Inc.
DCE	dichloroethene
DEHP	Bis(2-ethylhexyl)phthalate
DHS	California Department of Health Services
DNAPL	dense nonaqueous phase liquid
DO	dissolved oxygen
DOGGR	California Department of Conservation, Division of Oil, Gas, and Geothermal Resources
DOT	Department of Transportation
DQO	data quality objective
DTSC	Department of Toxic Substances Control
DWC	Diversity Wyandotte Corporation
EC	electrical conductivity
ELCR	excess lifetime cancer risk

EPA	United States Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
eV	electron-volt
EW	extraction well
Freon 11	trichlorofluoromethane
Freon 113	trichlorotrifluoromethane
fs	sleeve friction
FS	feasibility study
FSP	field sampling plan
ft/day	feet per day
ft/ft	feet per foot
ft ²	square foot
ft ² /min	square foot per minute
GC/MS	gas chromatograph/mass spectrometer
gpm	gallons per minute
GPS	global positioning system
H	Henry's Law constant
HCL	hydrochloric acid
HHRA	human health risk assessment
HP	HydroPunch®
HQ	hazard quotient
HSA	hollow-stem auger
HSDB	Hazardous Substances Data Bank
HVAC	heating, ventilation, and air conditioning
ID	inside diameter
IDW	investigation-derived waste
Kr	hydraulic conductivity
LACDHS	Los Angeles County Department of Health Services
LADPW	Los Angeles Department of Public Works
LARWQCB	Los Angeles Regional Water Quality Control Board

LAR	Liability Analysis Report
LNAPL	light nonaqueous phase liquid
LNR	long normal resistivity
LUFT	leaking underground fuel tank
MCL	maximum contaminant level
MEK	methyl ethyl ketone
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MIBK	methyl isobutyl ketone
min	minute
MIP	membrane interface probe
mL	milliliter(s)
mL/ft	milliliters per foot
mL/min	milliliters per minute
mm	millimeter(s)
Modine	Modine Manufacturing Company
MS	matrix spike
MSD	matrix spike duplicate
msl	mean sea level
MTBE	methyl-tert-butyl-ether
MW	monitoring well
NAD	North American Datum
NAPL	nonaqueous phase liquid
ND	nondetection
NDMA	N-nitrosodimethylamine
NGVD	National Geodetic Vertical Datum
NL	notification level
NPL	National Priorities List
NTU	nephelometric turbidity unit
OD	outside diameter
OEHHA	Office of Environmental Health Hazard Assessment

OFRP	Oil Field Reclamation Project
Omega	Omega Chemical Corporation
Omega Site	Omega Chemical Superfund Site
OPOG	Omega Chemical Site PRP Organized Group
ORP	oxidation-reduction potential
OSHA	U.S. Occupational Safety and Health Administration
OSS	Onsite Soils (work plan)
OSVOG	Omega Small Volume Organized Group
OU	operable unit
OU1	Operable Unit 1
OU2	Operable Unit 2
OU3	Operable Unit 3
OVA	organic vapor analyzer
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PHG	public health goals
PID	photoionization detector
PP	push-probe sampling
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PRG	preliminary remediation goal
PRP	potentially responsible party
psi	pounds per square inch
PVC	polyvinyl chloride
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
qc	tip resistance
QC	quality control

QED	QED Environmental Systems
RCRA	Resource Conservation and Recovery Act
Rf	friction ratio
RfD	reference dose
RFA	request for analyses
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RME	reasonable maximum exposure
RPD	relative percent difference
RPM	remedial project manager
RWQCB	Regional Water Quality Control Board
SAIC	Science Applications International Corporation
SB	stratigraphic boundaries
SBT	soil behavior type
SCC	Southern California Chemical
SDG	sample delivery group
SIM	select ion mode
Simulprobe	Maxiprobe Simulprobe® Sampling System
SLERA	Screening Level Ecological Risk Assessment
SLIC	Spills, Leaks, Investigation, and Cleanup Cost Recovery
SNR	short normal resistivity
SOW	Statement of Work
SP	spontaneous potential
SPT	standard penetration test
STL	Severn Trent Laboratory
SVE	soil vapor extraction
SVOC	semivolatile organic compound
TCA	trichloroethane
TCE	trichloroethene
TDS	total dissolved solids
THM	trihalomethane

TIC	tentatively identified compounds
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TPH-d	total petroleum hydrocarbons as diesel
TPH-g	total petroleum hydrocarbons as gasoline
trans-1,2-DCE	trans-1,2-dichloroethene
trans-1,3-DCP	trans-1,3-dichloropropene
TTLc	total threshold limit concentration
U	penetration pore pressure
UAO	Unilateral Administrative Order
USA	Underground Service Alert
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USGS	United States Geological Survey
UST	underground storage tank
UTM	Universal Transverse Mercator
VOA	volatile organic analysis
VOC	volatile organic compound
WDC	Water Development Corporation
WDI	Waste Disposal, Inc.
Weston	Weston Solutions, Inc.
WRD	Water Replenishment District of Southern California
yd ³	cubic yards

1. Introduction

The United States Environmental Protection Agency (EPA), under the authority of the Comprehensive Environmental Response, Comprehensive, and Liability Act of 1980 (CERCLA), is conducting a remedial investigation/feasibility study (RI/FS) to address groundwater contamination at the Omega Chemical Corporation Superfund Site (Omega Site) downgradient of the former Omega Chemical, Inc. (Omega) property located in Whittier, California (Figure 1-1).

EPA manages the Omega Site as three operable units: Operable Unit 1 (OU1), which includes the contaminated soil and groundwater in the immediate vicinity of the former Omega property; Operable Unit 2 (OU2), comprising the groundwater contamination downgradient of OU1; and Operable Unit 3 (OU3), comprising the indoor air contamination at the former Skateland building and other buildings. This RI report presents the results of EPA's investigation of the OU2 area, which EPA began in 2001. The purpose of the RI is to evaluate the nature and extent of groundwater contamination and to assess the potential risks posed by this contamination to human health and the environment. The results of the RI will:

- Support the determination of risk-based cleanup levels; and
- Lay the foundation for the development and evaluation of possible cleanup alternatives in the feasibility study (FS).

Figure 1-2 summarizes the phases of the overall Superfund remedial response process (or CERCLA process) and shows the status of progress on the Omega Site. This section of the RI report describes the report development and organization, site background, and historical and recent site investigations.

1.1 Report Development and Organization

EPA has prepared this draft RI report in consultation with stakeholders including the State of California Department of Toxic Substances Control (DTSC), the lead state agency for National Priorities List (NPL) sites, and the United States Geological Survey (USGS). As such, this document provides a forum for those stakeholders with an interest in developing a better understanding of groundwater contamination in OU2.

This report presents several important aspects of the RI for the OU2 area:

- **Site Investigation and Data Collection** – The report summarizes the history of the Omega Site and RI activities performed by EPA.
- **Data Analysis** – The report presents EPA's evaluation of data collected during the RI.
- **Conceptual Site Model** – The report describes EPA's refined understanding or conceptual model of groundwater contamination for the Omega Site.

- **Risk Assessment** – The report presents the results of a baseline risk assessment conducted for the Omega Site.
- **Recommendations** – The report identifies any additional data that may be needed and presents recommendations for future investigation and remediation work for the Omega Site.

The remainder of this document is organized as shown in Table 1-1. Figures and tables are provided at the end of each section in which they are discussed.

1.1.1 Terminology

The following terms were adopted for the purpose of the OU2 RI report:

Omega Site	The Omega Site (or Omega Chemical Corporation Superfund Site) consists of three Operable Units (OU1, OU2, and OU3) as described below.
Omega property	The Omega property (also referred to in this report as the “former Omega Chemical property”) is the location of the former Omega Chemical Corporation facility and occupies Los Angeles County Assessor Tract Number 13486, Lots 3 and 4 with street addresses 12504 and 12512 East Whittier Boulevard.
Omega Wells	This term means (a) wells installed by EPA and the potentially responsible party (PRP) group named Omega Small Volume Organized Group (OSVOG), and (b) wells installed by the Omega Chemical Site PRP Organized Group (OPOG).
Omega Contaminants	Omega Contaminants are chemicals found at concentrations exceeding their screening levels (shown in Tables 5-1 to 5-4) at OU1 wells OW1A, OW1B, OW2, OW3A, OW3B, OW8A, and OW8B. These compounds are believed to have been introduced to groundwater as a result of the hazardous substances released at the former Omega facility. The same chemicals are also believed to have been introduced to groundwater at other facilities throughout OU2. Omega Contaminants also include the degradation products of these chemicals.
Chemicals of Potential Concern (COPCs)	COPCs are all chemicals found at concentrations exceeding their screening levels in OU2. They may have originated from hazardous substances released from known and unknown sources. Some of these compounds may be naturally occurring. Treatment of these chemicals will potentially be required for the groundwater remedy.
Operable Unit 1 (OU1)	OU1 is an area encompassing the former Omega Property and extending about 100 feet southwest across Putnam Street.
Operable Unit 2 (OU2)	OU2 is defined by the extent of the Omega Contaminants that are above screening levels in groundwater. Within OU2, groundwater contamination from the Omega property has commingled with chemicals released at other source areas; consequently, it is not always possible to distinguish exactly the extent of hazardous substances released from individual sources.
Operable Unit 3 (OU3)	OU3 is defined by the extent of indoor air impacts at the former Omega Chemical property as well as adjacent and nearby properties where the underlying vadose zone has been impacted by contamination derived from the former Omega Chemical property.
Source of groundwater contamination source areas	Sites (or properties) that have impacted groundwater by release(s) of chemicals at concentrations above their screening levels are referred to as sources of contamination, or source areas. The use of operator names in identifying the properties is not necessarily intended to imply liability.

1.2 Site Background

1.2.1 Physical Location

EPA manages the Omega Site as three operable units (OU1, OU2, and OU3). OU1 includes the soil and groundwater contamination at the former Omega facility, located at 12504 and 12512 East Whittier Boulevard, and approximately 100 feet west-southwest of Putnam Street (Figure 1-3). The Omega property occupies Los Angeles County Assessor Tract Number 13486 (Lots 3 and 4). It covers an area of approximately 41,000 square feet (200 feet wide by 205 feet long) and contains two structures, a 140-foot by 50-foot warehouse and an 80-foot by 30-foot administrative building. A loading dock is attached to the rear of the warehouse. The Omega property is paved with concrete and secured with a 7-foot-high perimeter fence and locking gate. The fence is topped with razor wire. Prior to construction of buildings at the Omega property in July 1951, the property was used for agriculture.

OU2 generally includes the groundwater contaminated area that extends from the former Omega facility to approximately 4.5 miles south-southwest of the site. A site map showing the approximate boundaries of OU1 and OU2 is presented in Figure 1-4.

EPA created OU3 to address indoor air impacts at the former Omega Chemical property as well as adjacent and nearby properties where the underlying vadose zone has been impacted by contamination derived from the former Omega Chemical property.

1.2.2 Regulatory History

The following summary of the regulatory history of the former Omega facility was based on information summarized in the Request for a Removal Action (EPA, April 6, 2006) and the Onsite Soils (OSS) RI/FS Workplan (Camp, Dresser & McKee [CDM], September 2003).

The Omega Chemical Corporation (Omega) was a refrigerant/solvent recycling facility that operated from approximately 1976 to 1991. Drums and bulk loads of waste solvents and chemicals from various industrial activities were processed to produce commercial products. Wastes generated from treatment and recycling activities included still bottoms resulting from distillation of spent solvents, aqueous fractions, and nonrecoverable solvents.

Environmental regulatory action at the Omega Site began with several notices of violations from the Los Angeles County Department of Health Services (LACDHS). On November 1990, the Los Angeles County Superior Court issued a preliminary injunction to prevent further acceptance of offsite hazardous waste. In February 1991, Los Angeles County and San Bernardino County District Attorney's offices issued warrants to search three railcars at the site. The search revealed illegal storage and transport of 700 hazardous waste drums, falsified waste manifests, and drum labels. As a result, the Los Angeles County Superior Court ordered Omega to cease all operations, remove all hazardous wastes, and close the facility. EPA entered into an Administrative Order of Consent in October 1991 requiring Omega to perform several interim measures to mitigate current or potential threats to human health and the environment and to submit a Resource Conservation and Recovery Act (RCRA) facility investigation. At that time, the California Environmental Protection Agency (Cal-EPA)/DTSC was the lead agency at the Omega Site.

Although the Omega facility officially closed in 1991, the president and owner of the company continued to operate under a different company name on a limited basis, accepting primarily refrigerants (Freons). DTSC requested assistance from EPA to conduct a site assessment in August 1993. The site assessment revealed that approximately 2,900 drums of hazardous waste were at the site in weathered condition, but not completely corroded or leaking. In 1995, the company manager was found guilty of contempt of court by the Los Angeles County Superior Court and was ordered to cease all operations. Operations ceased at the Omega facility at that time.

On May 9, 1995, EPA issued a Unilateral Administrative Order (UAO) to PRPs that had shipped more than 10 tons of hazardous wastes to Omega. At that time, EPA became the lead agency at the site. The PRPs subsequently formed a group and established OPOG to perform the work. Between 1995 and 1996, OPOG removed approximately 2,700 drums from the site and conducted a preliminary site investigation. By that time, a majority of the drums were in extremely poor condition, and spills were observed in numerous locations. The Omega Site was placed on the NPL in January 1999. OPOG entered into a partial Consent Decree (CD) in February 2001. Under the CD's Statement of Work (SOW), OPOG has performed an RI/FS for the vadose zone soil at OU1, including a human health risk assessment (HHRA) for the vadose zone soils, completed an Engineering Evaluation/Cost Analysis to evaluate OU1 groundwater cleanup alternatives and is in the process of installing an interim groundwater remedy.

Upon evaluating data collected for the OU1 RI, it was found that soil vapor had migrated into several buildings near or at the site including "Skateland," an indoor roller-skating rink. EPA created Operable Unit 3 (OU3) to mitigate indoor air contaminant vapor intrusion at Skateland and potentially other buildings. EPA issued an Action Memorandum for a removal action to mitigate the vapor intrusion at Skateland on April 6, 2006. OPOG entered into the First Amendment to the CD and agreed to mitigate the indoor vapor exposure at Skateland or conduct an Alternate Response Action (EPA, April 6, 2006). After undertaking some of the testing work prior to selecting an appropriate mitigation measure, OPOG elected to purchase the property and close Skateland operations. The Skateland building was subsequently demolished in March 2007.

1.2.3 Omega Facility History and Operation

1.2.3.1 Current Use

Van Owen Holdings LLC of Los Angeles, California, purchased the property in 2003 and owns the property to the present day. The former Omega facility is divided into two parcels:

- Northern parcel – 12504 Whittier Boulevard. Currently being leased by Star City Auto Body to conduct automotive body repair and painting. The auto body shop also leases the small paved parking lot north of the warehouse building for automobile parking.
- Southern parcel – 12512 Whittier Boulevard. The former administrative building and the paved parking area south of the warehouse have had a variety of tenants since the 2003 purchase of the property. The former administrative building is currently vacant; the parking lot was used for temporary storage of wooden pallets by L&M Pallets on a month-to-month lease basis at the time of this RI. The building was previously used for administration and equipment storage, while the concrete paved exterior yard was used

for parking and temporary storage of heavy construction equipment. Ten soil vapor extraction (SVE) wells were installed at five locations in the parking lot during September 2006 and were used by OPOG for SVE pilot testing.

1.2.3.2 Former Use

The known environmental history of the Omega property was documented in the Data Summary Report prepared by CDM in December 2001 (CDM, December 4, 2001) and a facility History Memorandum prepared by Science Applications International Corporation (SAIC) in July 2006 (SAIC, July 10, 2006).

A summary of property owners/operators is provided below:

- Late 1930s – property was undeveloped or used for agricultural purposes.
- 1951 – property developed; office and warehouse were constructed for Sierra Manufacturing Company. Later created Sierra Bullets, Inc. in 1955. Operations including manufacturing of metal jacketed rifle and pistol projectiles and metal cups for detonation devices. During operation of the Sierra Bullet facility, a 500-gallon underground storage tank (UST) was utilized for storage of kerosene. Trichloroethene (TCE) also was reportedly used at the site.
- 1963 through 1966 – northern property purchased and occupied by Fred R. Rippy, Inc. for the purposes of die making and operation of a stamping machine shop.
- 1966 through 1974 – northern property used to convert vans to ambulances.
- 1974 through 1976 – northern property occupied by Bachelor Chemical Processing. Operations reportedly included the recycling of Freons.
- 1976 – Omega Chemical Corporation (Mr. Dennis O'Meara) purchases Bachelor Chemical Processing (northern parcel) and assumes the property lease.
- 1987 – Omega purchases the leased parcel and adjoining southern parcel from Rippy.
- April 11, 1991 – Omega ordered by the Superior Court of the County of Los Angeles to cease operation, remove all hazardous wastes, and close the facility.
- September 1991 – Omega files Chapter 11 bankruptcy, which was dismissed on September 7, 1993.

The former Omega facility provided treatment of commercial and industrial solid and liquid wastes and a transfer station for the storage and consolidation of wastes to be shipped to other treatment and/or disposal facilities. According to its October 29, 1990, Operation Plan for Hazardous Waste Recovery the Omega facility maintained 11 treatment units comprised of distillation columns, reactors, wipe film processor, liquid extractor, and solid waste grinder. The facility also maintained 22 stainless steel tanks with capacities ranging from 500 to 10,000 gallons, and 5 carbon steel tanks with capacities of 5,000 gallons (CDM, December 4, 2001).

From approximately 1999 through 2001, the northern parcel (12504 Whittier Boulevard) was leased by Mr. Nicholas Stymuiank who occupied the warehouse and stored miscellaneous

equipment and materials in the warehouse and service yards. The warehouse was converted in 2003 to be used by Star City Auto Body for auto body repair.

During the past few years, several tenants have occupied the southern parcel (12512 Whittier Boulevard). C&I Electric utilized the property for equipment and billboard storage. Following the termination of the C&I Electric lease, Three Kings Construction occupied the property. In December 2006, L&M Pallets leased the exterior yard for pallet storage.

1.3 Historical and Recent Site Investigations

1.3.1 Historical Investigations at OU2

Weston Solutions, Inc. (Weston), an EPA contractor, performed the first OU2 field investigations in 2001. The initial phase included the installation of 30 cone penetrometer test (CPT) probes for lithologic logging, collection of groundwater samples from CPT borings at 80 locations, and laboratory analysis of groundwater samples for volatile organic compounds (VOCs). Results of the initial phase are included in the Phase 1 Groundwater Characterization Study (Weston, February 2002). The second phase included installation of six CPT probes and 19 hollow-stem auger (HSA) borings for lithologic logging, installation of 18 monitoring wells for lithologic logging and future monitoring, collection of groundwater samples at 34 CPT probe and HSA boring locations, and laboratory analysis of groundwater samples for VOCs. Results of the Phase 2 investigation are included in the Phase 2 Groundwater Characterization Study (Weston, June 2003).

The 18 EPA monitoring wells were sampled quarterly since February 2002 along with 10 OU1 wells monitored by OPOG; semiannual monitoring started in 2006. Results are presented in groundwater monitoring reports prepared by EPA and OPOG. CH2M HILL began routine sampling of the EPA wells in March 2004.

In January 2004, EPA issued a UAO (EPA, 2004a; the 2004 UAO) to certain PRPs that had not signed the Partial CD to perform RI/FS work. The 2004 UAO was amended in June 2004 (EPA, 2004b; First Amended UAO). Fifteen of the parties named in the First Amended UAO, known as OSVOG, performed consultant and field services to comply with the First Amended UAO. As part of the SOW, OSVOG installed 23 monitoring wells (at 12 locations) and 1 extraction well between May 2005 and April 2006, and sampled the new wells in June 2006. The results of this investigation are published in the Final Project Completion Report (ARCADIS, March 2007).

CH2M HILL performed oversight of the OSVOG construction activities and evaluated the OU2 hydrogeology and extent of groundwater contamination based on information from the new wells, recent groundwater monitoring results, and information from other contaminated sites that are under the Los Angeles Regional Water Quality Control Board (LARWQCB) or DTSC oversight. EPA concluded that additional wells were needed to complete the characterization of the extent of groundwater contamination in OU2.

EPA also concluded that there were several suspected sources of groundwater contamination in OU2 (other than the former Omega facility) that might be contributing to the OU2 plume and undertook a review of State of California agency files to evaluate those potential sources.

1.3.2 File Review

CH2M HILL conducted a file review in 2005 to identify facilities that are potential sources of groundwater contamination in OU2 (other than the former Omega facility). To identify the other potential contaminant sources, CH2M HILL reviewed state and local agency files for facilities within the OU2 area and developed a list of known or potential sources of VOC contamination in groundwater in the area. EPA performed further records searches and determined that no further investigation was required to substantiate the existence of several of the known sources of contamination. A more detailed discussion of the history and contaminant distribution at the following source areas is presented in Section 5.

Sites (or properties) that have impacted groundwater are referred to as sources of contamination, or source areas. The main sources of contamination at OU2 have been identified based on information obtained from file reviews and findings from field investigations. Other as yet unidentified sources of groundwater contamination may exist within the OU2 area. The following sections occasionally identify a source area with reference to the name of a facility that operated and/or continues to operate on the property within such source area. This report is not intended to include all entities that may have contributed to contamination at such source areas. The use of operator names in identifying the properties is not necessarily intended to imply liability.

1.3.2.1 Known Sources of Groundwater Contamination

The following is a list of known sources of contamination that require no further investigation to support the RI:

- Foss Plating Co., Inc. ("Foss Plating") – 8140 Secura Way, Santa Fe Springs, California
- Phibro-Tech, Inc. ("Phibro-Tech") – 8851 Dice Road, Santa Fe Springs, California
- Bodycote Thermal Processing, Inc. ("Techni-Braze") – 11845 Burke Street, Santa Fe Springs, California
- Pilot Chemical Corporation ("Pilot Chemical") – 11756 Burke Street, Santa Fe Springs, California
- Angeles Chemical Co., Inc. ("Angeles") – 8915 Sorensen Avenue, Santa Fe Springs, California
- McKesson Facility ("McKesson") – 9005 Sorensen Avenue, Santa Fe Springs, California
- Modine Manufacturing Company ("Modine Manufacturing") – 12252 East Whittier Boulevard, Whittier, California
- "Site A" – 12128 Burke Street, Santa Fe Springs, California.
- CENCO Refinery – 12345 Lakeland Road, Santa Fe Springs, California
- G&M Oil Company – 12559 Lambert Road, Whittier, California
- The Santa Fe Springs Oil Field and the Oil Field Reclamation Project (OFRP) – former oil fields located in Santa Fe Springs, California
- Unocal Corporation – 9645 South Santa Fe Springs Road, Santa Fe Springs, California

1.3.2.2 Potential Sources of Groundwater Contamination at OU2

The following facilities were determined to be potential sources of contamination based on available file review information:

- “Site B” – 8921 Dice Road, Santa Fe Springs, California
- “Site C” – 9120-9160 Norwalk Boulevard and 11925-11933 Los Nietos Road(aka 9100 Norwalk Blvd.), Santa Fe Springs, California
- “Site D” – 8421 South Chetle Avenue, Santa Fe Springs, California
- “Site E” – 12200 Los Nietos Road, Santa Fe Springs, California
- Earl Manufacturing – 11862 Burke Street, Santa Fe Springs, California
- “Site F” – 8623 South Dice Road, Santa Fe Springs, California
- “TCE Source at Whittier Boulevard” – located in the vicinity of Whittier Boulevard and Mar Vista Street, Whittier, California

A map of the above facilities is presented in Figure 1-5. Further field investigations were conducted as part of the RI to characterize the contaminant distribution near five of these suspected source areas. A discussion of the field methods and results are presented in Sections 2 and 5, respectively.

1.3.2.3 Other Sites

Information from the following facilities was used in support of this RI:

- Ashland Chemical – 10505 South Painter Avenue, Santa Fe Springs, California
- Lincoln Distribution Center – 12500 Slauson Avenue, Santa Fe Springs, California
- Valvoline Oil Company (“Valvoline Oil”) – 9520 John Street, Santa Fe Springs, California
- Waste Disposal, Inc. Superfund Site (“WDI”) – Los Nietos Road at Greenleaf Avenue, Santa Fe Springs, California

1.3.3 Recent Investigations at OU2

1.3.3.1 Routine Groundwater Sampling

Routine sampling of EPA’s monitoring well network has been conducted by CH2M HILL since March 2004. The last sampling round for which analytical data are included in this RI report was conducted in July-August 2007. CH2M HILL will continue to monitor the EPA wells on at least a semiannual basis, or as directed by EPA. Further discussion of the routine groundwater sampling conducted by CH2M HILL and other consultants is presented in Section 2.

1.3.3.2 Additional Field Investigation Activities

EPA contracted with CH2M HILL to complete the RI field investigation at OU2. Activities of the field investigation were conducted in accordance with CH2M HILL’s field sampling plan (FSP) (CH2M HILL, July 2004) and FSP addendum (CH2M HILL, November 2006).

Field activities performed include the installation of four single-screen and four multiple-screen (nested) monitoring wells. The purpose of the wells was to characterize the horizontal and vertical extent of the groundwater contaminant plume.

A second component of the field investigation included the collection and analysis of HydroPunch® groundwater samples near the five facilities suspected to be sources of VOC contamination. Characterization of these potential source areas was required for selecting an appropriate remedy for OU2.

The third and last component of the field investigation included the sampling of soil gas, soil, and groundwater in a residential apartment community located approximately 2,000 feet west of the former Omega facility (Figure 1-5). The purpose of this investigation was to evaluate the human health risks associated with potential soil gas vapor intrusion into indoor air. The residential area was of potential concern due to the relatively shallow depth of groundwater and relatively high concentration of VOCs beneath this area.

The results of the monitoring well installation and routine groundwater sampling, source area investigation, and residential area sampling are presented in Section 5. These data were subsequently evaluated as part of the HHRA for OU2.

Table 1-1
Report Organization
Omega Chemical Superfund Site

RI Report Section	Title	Subject
1	Introduction	General background, purpose of the RI report, site-specific background information, and an overview of previous investigation activities at the former Omega Facility and OU2.
2	EPA RI Field Activities	A summary of EPA RI activities, including field investigation and sampling activities and methodologies, data quality objectives, contaminant source and groundwater investigations, and community involvement.
3	Data Quality	Summary of chemical data quality, including split sample results, data validation, and overall data assessment.
4	Physical Characteristics of the Study Area	Physical characteristics of OU2, including surface features, climate, hydrology, geology, hydrogeology, and land use.
5	Nature and Extent of Contamination	Nature and extent of contamination, including contaminant sources, and groundwater, soil, and vadose zone contamination.
6	Contaminant Fate and Transport	Contaminant fate and transport including potential migration routes, transport processes, and contaminant persistence.
7	Baseline Risk Assessment	Summary of the baseline human health risk assessment and screening-level ecological risk assessment.
8	Summary, Findings, and Recommendations	Summary, findings, identification of data gaps, and recommendations for future work.
9	References	References.

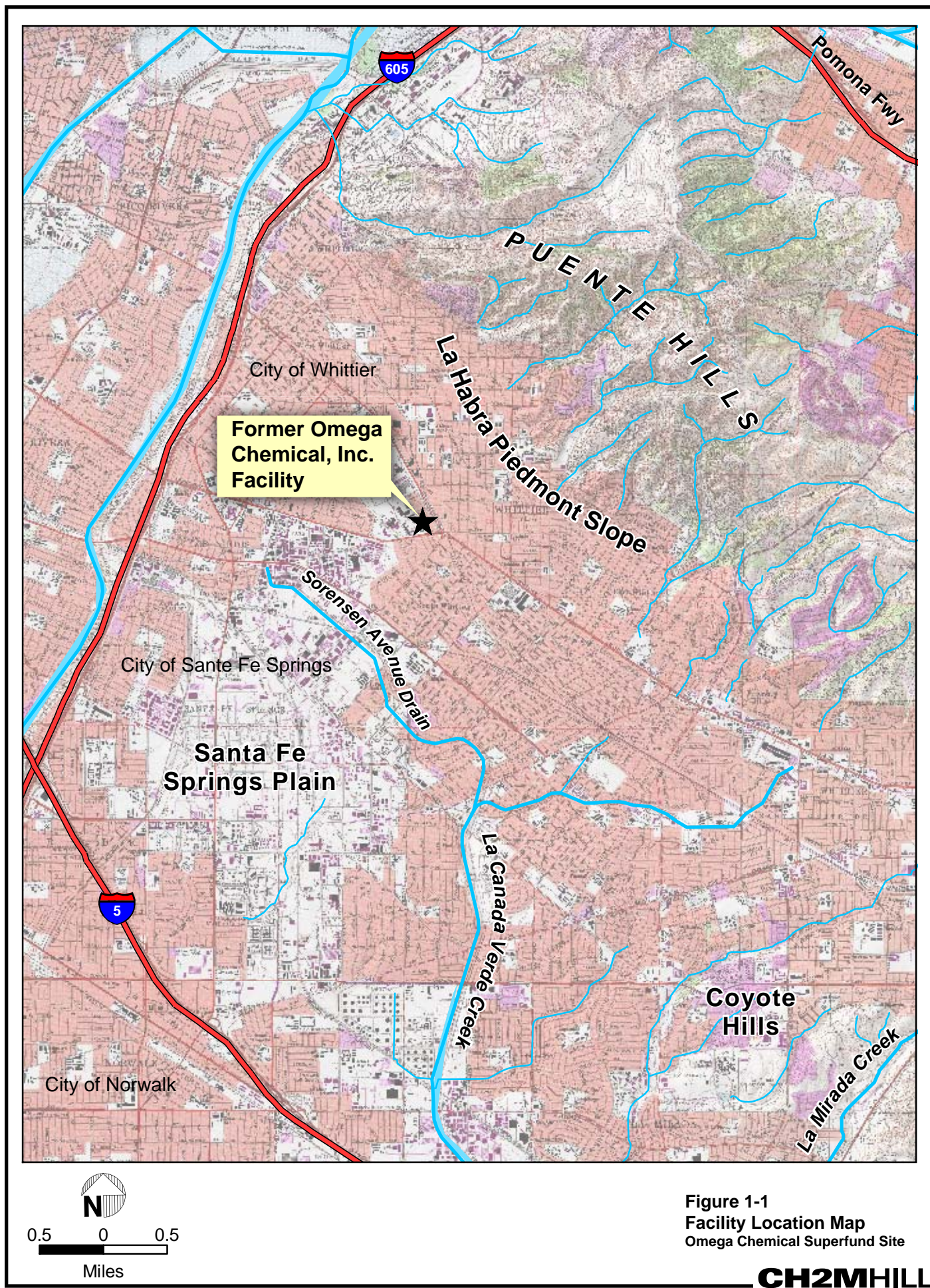
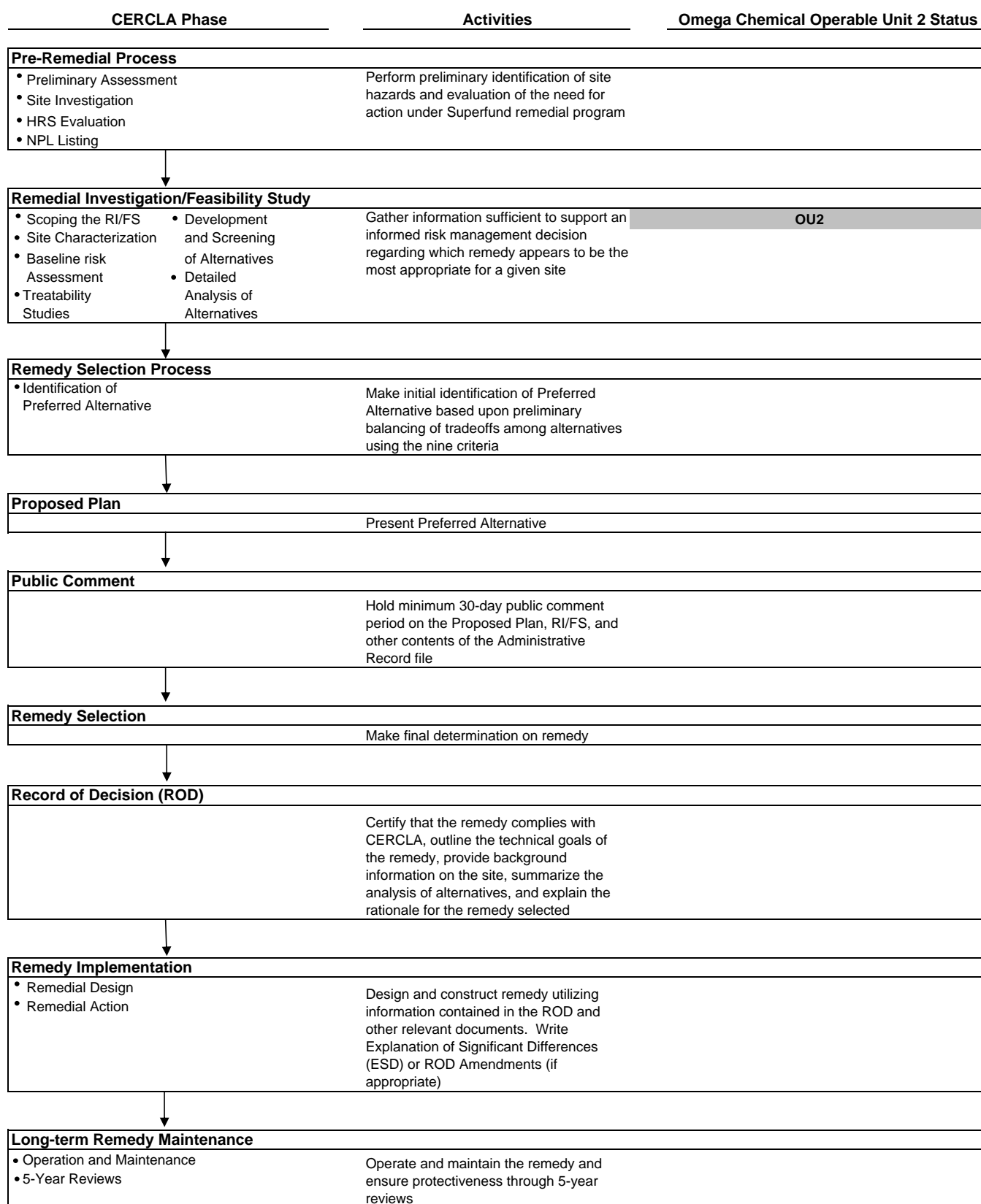
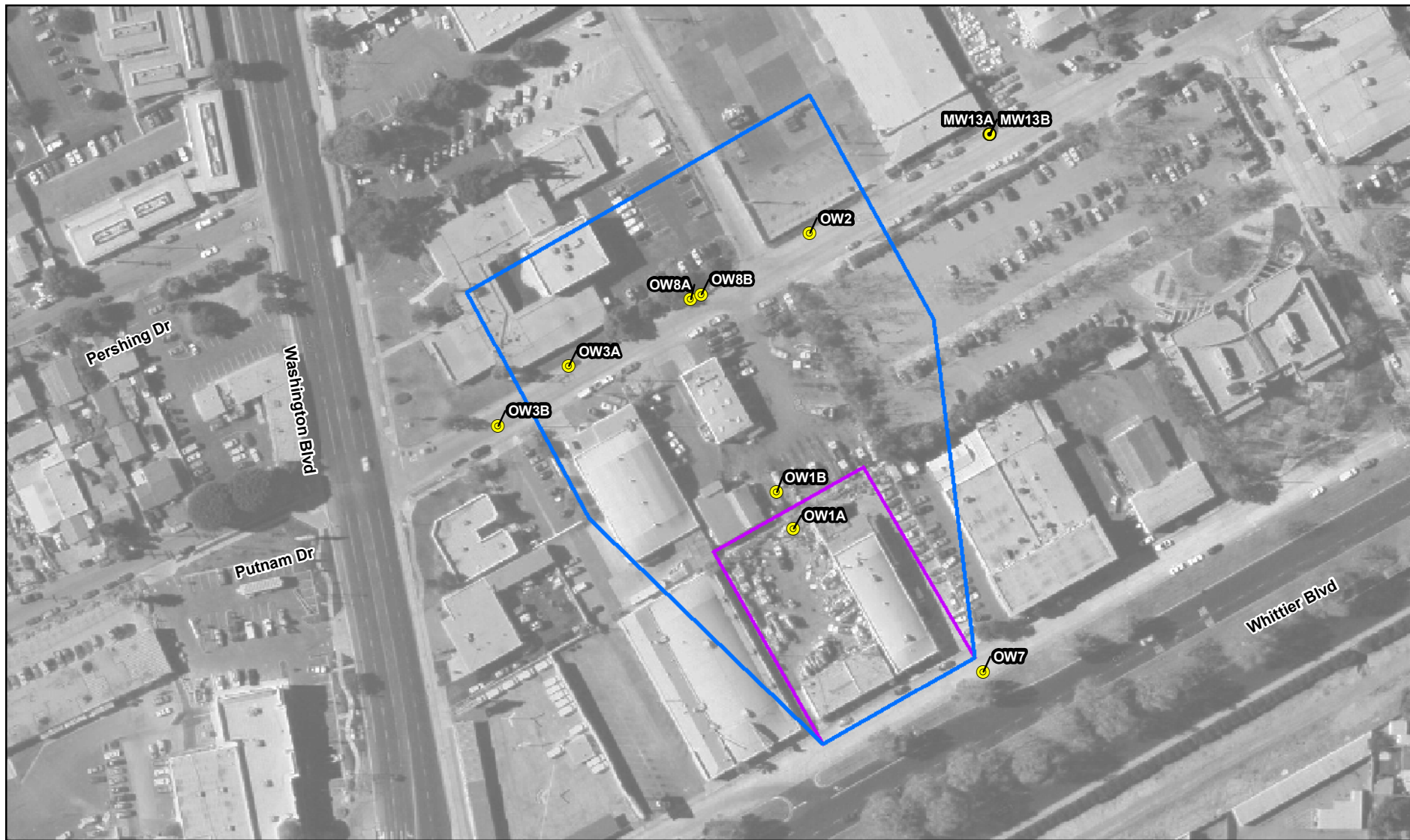


Figure 1-1
Facility Location Map
Omega Chemical Superfund Site



Modified from the Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents (EPA, 1999).

Figure 1-2
OU2 Site Status
Omega Chemical Superfund Site



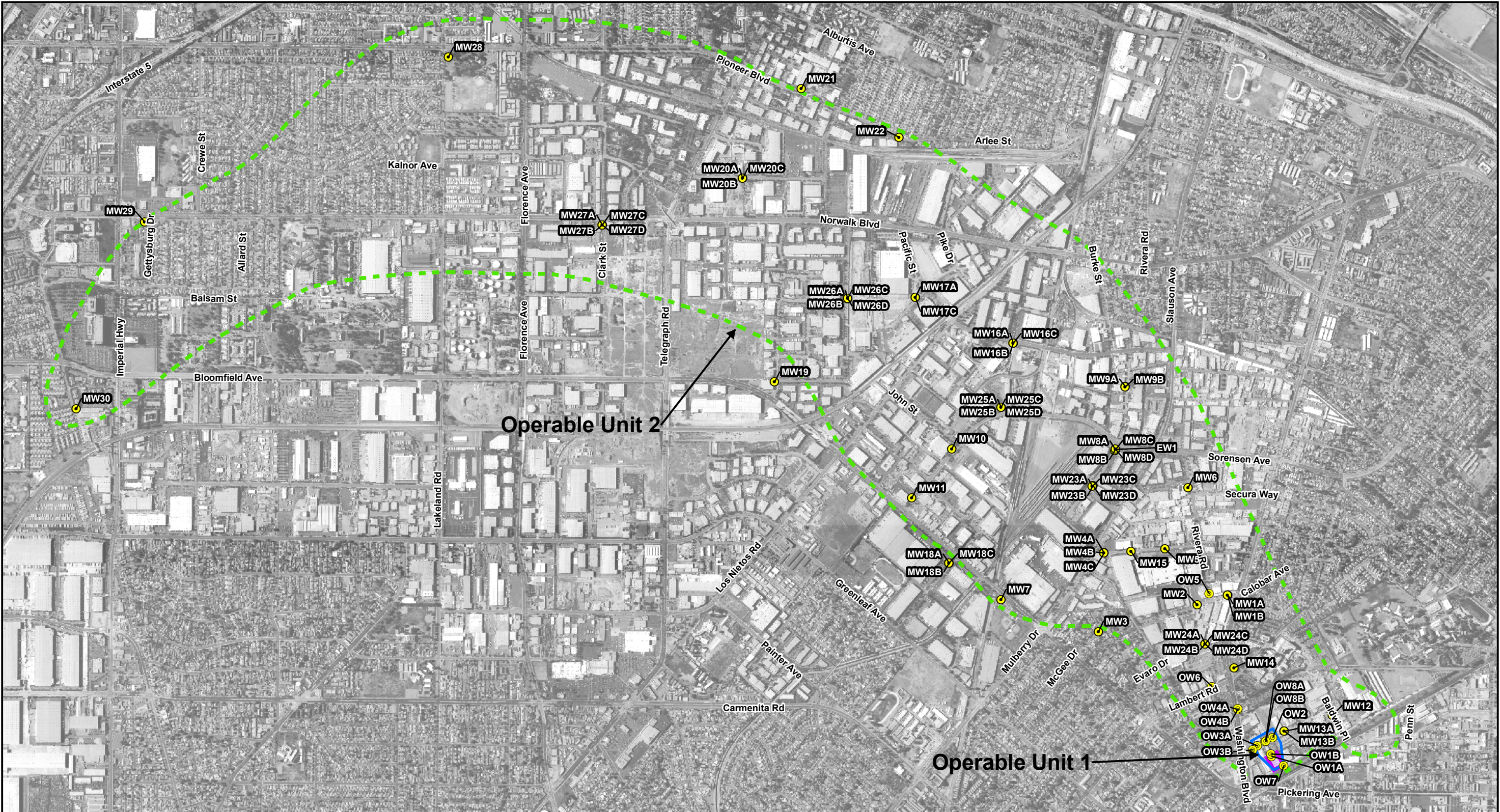
Aerial Date: March 2004, USGS

Legend

- Former Omega Facility
- Operable Unit 1






Figure 1-3
Operable Unit Location Map Unit 1
 Omega Chemical Superfund Site



Aerial Date: March 2004, USGS

Legend

-  Operable Unit 1
-  Operable Unit 2
-  Former Omega Facility



0 1,600 3,200 Feet

Figure 1-4
Operable Unit Location Map
Units 1 and 2
Omega Chemical Superfund Site



Date: May 30, 2008

2. EPA Remedial Investigation Field Activities

This section of the RI report summarizes the OU2 field activities conducted by CH2M HILL between March 2004 and July 2007. Additional monitoring well construction and groundwater analytical data provided by other parties are included to support the RI objectives, including the development of a hydrogeologic conceptual model of the Omega Site, assessment of the nature and extent of regional groundwater contamination and contaminant sources, assessment of risk to human health and the environment posed by groundwater contamination, and development of a future FS.

The initial planning documents prepared by CH2M HILL include the FSP (CH2M HILL, July 2004) and quality assurance project plan (QAPP) (CH2M HILL, July 2004). The FSP provides a detailed description of field methods and sampling protocols associated with the RI. Activities discussed include routine groundwater sampling, well construction and development, aquifer testing, surveying, and containment and disposal of investigation-derived waste (IDW). The FSP was developed in accordance with *EPA Guidance for Preparation of a U.S. EPA Region IX, Field Sampling Plan for EPA-Lead Superfund Projects* (EPA, 1993).

The QAPP presents sampling and analytical protocols as well as the quality assurance (QA) and quality control (QC) procedures for the RI. Data quality objectives (DQOs) also are included in the QAPP. The QAPP follows EPA guidelines contained in *EPA Guidance for Quality Assurance Project Plans* (EPA, 2002) and *EPA Requirements for Quality Assurance Project Plans* (EPA, 2001).

CH2M HILL prepared FSP and QAPP addenda in November 2006 to provide a description of field methods and sampling/analytical protocol for additional field activities including well installation, aquifer testing, discrete (HydroPunch®) sampling, CPT, depth-discrete sampling during well construction, soil gas probe installation and sampling, and in situ soil sampling. The addenda were prepared as supplements to the existing FSP and QAPP; therefore, sections that were previously included in the original planning documents were not repeated.

A summary of the above-mentioned CH2M HILL planning documents is provided below:

- Field Sampling Plan for Omega Chemical Superfund Site Operable Unit 2, Remedial Investigation/Feasibility Study (CH2M HILL, July 2004)
- Quality Assurance Project Plan, Omega Chemical Superfund Site Operable Unit 2, Remedial Investigation/Feasibility Study (CH2M HILL, July 2004)
- Field Sampling Plan for Omega Chemical Superfund Site Operable Unit 2, Remedial Investigation/Feasibility Study Addendum 1 (CH2M HILL, November 2006)
- Quality Assurance Project Plan, Omega Chemical Superfund Site Operable Unit 2, Remedial Investigation/Feasibility Study Addendum 1 (CH2M HILL, November 2006)

Three other parties have installed monitoring wells within OU2 that have been sampled by CH2M HILL as part of the RI. These parties include the following:

- **CDM (Consultant for OPOG)** – Constructed 11 monitoring wells (OW1A, OW1B, OW2, OW3A, OW3B, OW4A, OW5B, OW6, OW7, OW8A, and OW8B) at OU1 and OU2 between 1996 and 2006, as part of the OU1 RI. Boring logs, downhole geophysical logs, and well completion diagrams are included in Appendix A.1. CDM has performed groundwater sampling of these wells on a semiannual basis. CH2M HILL sampled the OPOG wells on a semiannual basis in 2004 to acquire complete quarterly sampling results.
- **Weston Solutions, Inc. (Consultant for EPA)** – Constructed 18 monitoring wells at 11 locations (MW1 to MW11) in December 2001, as part of the Omega Phase 2 Site Characterization Study. These include wells MW1A, MW1B, MW2, MW3, MW4A, MW4B, MW4C, MW5, MW6, MW7, MW8A, MW8B, MW8C, MW8D, MW9A, MW9B, MW10, and MW11. Boring logs, geophysical logs, and well completion diagrams are included in Appendix A.1. Each well was completed with a dedicated bladder pump and sampled using the low-flow method. Weston performed quarterly monitoring of these wells between February 2002 and August 2003. CH2M HILL has performed sampling of these wells at least semiannually since March 2004.
- **ARCADIS (Consultant for OSVOG)** – Constructed 23 monitoring wells at 12 locations (MW12 to MW23), and one extraction well (EW1) between May 2005 and April 2006. Wells MW12, MW14, MW15, MW19, MW21, and MW22 were completed as single-screen wells. Wells MW16, MW17, MW18, MW20, and MW23 were completed as triple-nested wells, and well MW13 was completed as a double-nested well. Well EW1 was completed as a single-screen 4-inch-diameter extraction well. Dedicated bladder pumps were installed in all but three monitoring wells (MW13A, MW17A, and MW19). Following one round of groundwater sampling, OSVOG transferred the new wells to EPA. CH2M HILL currently performs semiannual groundwater monitoring of these wells.

As requested by EPA, CH2M HILL evaluated the sampling results and identified several data gaps after completion of the OSVOG well installation. The main data gaps included the lateral and vertical extent of the contamination in groundwater, and characterization of sources of groundwater contamination within OU2. To address these data gaps EPA directed CH2M HILL to perform additional field investigations that included (1) the installation of four single-screen (MW23A, MW28, MW29, and MW30) and four quadruple-nested (MW24, MW25, MW26, and MW27) monitoring wells to characterize the vertical and lateral extent of the contaminant plume; (2) HydroPunch® groundwater sampling to identify sources of VOC contamination (other than the former Omega facility); and (3) soil gas investigation to characterize the risk of soil gas vapor intrusion into residential buildings. The soil gas investigation (also referred to as the residential area investigation) included soil gas probe installation and sampling, soil sampling for geotechnical analysis, CPT, and HydroPunch® groundwater sampling. Additionally, CH2M HILL performed aquifer testing to characterize the aquifer properties.

The discussion below summarizes the field methods used during CH2M HILL's routine groundwater monitoring between March 2004 and July 2007, and the supplemental field

activities conducted between January 2007 and July 2007. CH2M HILL's planning documents describe the field methodology in greater detail.

2.1 Routine Groundwater Sampling

The OU2 monitoring well network includes both OPOG and EPA wells. OPOG well names begin with the prefix "OW"; the EPA wells begin with the prefix "MW." Each prefix is followed by a sequential number (e.g., MW8) followed by a suffix "A" through "D" denoting the relative depth to the screened interval ("A" is used for the shallowest wells and "D" for the deepest wells). A map of all Omega (OPOG and EPA) monitoring wells is presented in Figure 2-1. Well construction details are provided in Table 2-1.

Dedicated pumps were not installed in the OPOG wells, only dedicated tubing. A 2-inch-diameter portable submersible pump was used for purging and sampling groundwater. Typically, three casing volumes are purged before sample collection (that is, OPOG does not use the low-flow sampling method).

Table 2-2 presents a summary of the OPOG routine groundwater monitoring schedule. The initial two sampling events were conducted at well OW1A in July 1996 and at wells OW1A, OW1B, OW2, and OW3A in July 1999. Quarterly sampling of wells OW1A to OW6 was initiated in May 2001. Semiannual sampling of wells OW1A to OW8A was initiated in February 2002 and has continued on a semiannual basis through August 2007. Parameters most frequently monitored include VOCs, 1,4-dioxane, and 1,2,3-trichloropropane (1,2,3-TCP). Less frequently monitored parameters include semivolatile organic compounds (SVOCs), dissolved metals, pesticides and polychlorinated biphenyls (PCBs), perchlorate, n-nitrosodimethylamine (NDMA), hexavalent chromium, and general chemistry (biochemical oxygen demand [BOD], chemical oxygen demand [COD], total organic carbon [TOC], total dissolved solids [TDS], alkalinity, and anions). A detailed description of the field methods and analytical protocol is provided in the following OPOG work plans:

- Sampling and Analysis Plan Addendum for Additional Data Collection in the Phase 1a Area, Omega Chemical Superfund Site (CDM, May 31, 2002)
- Downgradient Well Installation and Groundwater Monitoring Sampling and Analysis Plan, Omega Chemical Superfund Site (CDM, April 20, 2001)
- Final Sampling and Analysis Plan, Phase 1a Field Investigation (CDM, April 23, 1999)

Table 2-3 presents a summary of the Weston groundwater sampling schedule. Samples were collected on a quarterly basis between February 2002 and August 2003. Weston also sampled wells OW1A to OW8A during these quarterly events. A 2-inch-diameter portable submersible pump was used to sample the OPOG wells. Three casing volumes were purged prior to sample collection. EPA and OPOG well samples were analyzed for the following parameters: VOCs, SVOCs, dissolved metals, pesticides and PCBs, 1,4-dioxane, 1,2,3-TCP, perchlorate, cyanide, and general chemistry (TOC, TDS, alkalinity, and anions). A detailed description of the field sampling methods and analytical protocol is provided in the Weston SAP (Weston, 2001) and Phase 2 groundwater characterization study (Weston, June 2003). Weston discontinued their monitoring program after August 2003.

ARCADIS measured VOCs, SVOCs, dissolved metals, pesticides and PCBs, 1,4-dioxane, 1,2,3-TCP, perchlorate, NDMA, cyanide, and general chemistry (TOC, TDS, total Kjeldahl nitrogen [TKN], and anions). A complete description of the analytical and field methods is provided in the ARCADIS FSP plan (ARCADIS, January 18, 2005) and final project completion report (ARCADIS, March 2007).

Table 2-4 presents a summary of the CH2M HILL routine groundwater sampling schedule. Quarterly sampling of EPA wells MW1A to MW11 was initiated in March 2004. Samples were analyzed for the following parameters: VOCs, SVOCs, dissolved metals (including boron and silica), 1,4-dioxane, 1,2,3-TCP, perchlorate, NDMA, hexavalent chromium, anions (bromide, chloride, fluoride, nitrate-nitrogen, nitrite-nitrogen, orthophosphate-phosphorous, and sulfate), and other general chemistry parameters (alkalinity [total and bicarbonate], ammonia, BOD, COD, TKN, and total phosphorous). CH2M HILL also collected samples from wells OW1A to OW8A in June 2004 and November 2004. Samples were analyzed for the same parameters as the EPA wells. A detailed description of the sampling methods and groundwater sampling results for 2004 is presented in the CH2M HILL *Draft 2004 Annual Groundwater Monitoring Report* (CH2M HILL, March 2005).

EPA directed CH2M HILL to discontinue sampling of the OPOG wells after November 2004 because CDM monitors these wells on a semiannual basis during the same quarters as the CH2M HILL sampling events. Since the OPOG field QA and QC procedures are under EPA's direct oversight, the groundwater data provided by OPOG were deemed acceptable to use for this RI and the HHRA. To further maintain QA and QC of the data, CH2M HILL collects split groundwater samples during each OPOG groundwater sampling event. Typically, three split groundwater samples are collected and submitted to the EPA Region 9 laboratory for VOCs and 1,4-dioxane analysis. Split sampling results will be presented in a separate report for the OU1 oversight project.

Since February 2005, wells MW1 to MW11 were sampled by CH2M HILL on a semiannual basis and with a reduced analyte list, which includes VOCs and emergent compounds (1,4-dioxane, 1,2,3-TCP, perchlorate, NDMA, or hexavalent chromium). Wells MW12 to MW22, and MW23B, MW23C, and MW23D also were sampled on a semiannual basis and with a reduced analyte list since completion of these wells in early 2006. SVOCs were discontinued because, with the exception of bis(2-ethylhexyl)phthalate, no SVOC exceeded its respective maximum contaminant level (MCL). Monitoring of total cyanide, dissolved metals, anions, and general chemistry parameters also was discontinued. These constituents were analyzed primarily to evaluate groundwater treatment alternatives and treated groundwater discharge options. The sampling results indicated that most of these compounds are not COPCs within OU2. Lastly, all newly constructed wells were sampled for the full suite of analytes (e.g., VOCs, SVOCs, dissolved metals, etc.) immediately after well construction, and will be sampled for the reduced analyte list (VOCs and emergent compounds) during subsequent sampling events.

The most recent CH2M HILL sampling round was conducted in July-August 2007, after the construction of the new wells. This included four single-screen wells (MW23A, MW28, MW29, and MW30) and four quadruple-nested wells (MW24, MW25, MW26, and MW27). Wells MW1A to MW22, and wells MW23B, MW23C, and MW23D were analyzed for VOCs and emergent compounds. Wells MW23A and MW24 to MW30 were analyzed for the full suite of analytes (same as 2004 analyte list).

A discussion of the sampling procedures and analytical methods for groundwater data collected by CH2M HILL is presented below.

2.1.1 Sample Collection Methods

The following subsections describe CH2M HILL's general sample collection procedures for groundwater sampling at the OU2 monitoring well network. Groundwater sampling purge forms are provided in Appendix B.

2.1.1.1 EPA Well Sampling

EPA monitoring wells are equipped with dedicated pump tubing and bladder pumps to allow sampling using low-flow sampling techniques. Low-flow sampling is the process of purging and sampling wells at low flow rates from within the well screen zone to minimize the volume of extracted water and improve sample quality (EPA, 2004). During well purging, careful continuous measurement of field parameters including specific conductance, pH, temperature, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity were used to assess when purged water had reached equilibrium. A flow-through cell was used to ensure that the purge water was continuously monitored. Each well was pumped until conductance, pH, and temperature stabilized within 10 percent over three successive readings prior to collecting samples.

Well MW13A could not be sampled since this well has been dry since construction. Slow producing wells include wells MW12, MW17A, and MW19. Well MW12 is sampled using a passive sampling approach (i.e., the well is sampled without purging the bladder pump discharge tubing). No pumps are installed in wells MW17A and MW19. A disposable polyethylene bailer and new polyethylene string were used to sample these two wells.

2.1.1.2 OPOG Well Sampling

The OPOG sampling procedures are the same as described in the previous section for EPA wells, with the exception that a portable 2-inch-diameter stainless-steel pump was used for purging and sampling. OPOG wells have dedicated pump tubing, but not dedicated pumps. The portable pump was decontaminated between sampling of different wells using procedures described in the FSP. To minimize cross-contamination, wells were typically sampled from least to most contaminated wells. CH2M HILL used the low-flow method for sampling the OPOG wells. A bailer was sometimes used to sample well OW1A since it is a slow producing well.

2.1.1.3 Field Parameters Measurement

A digital conductivity-pH-temperature-DO-ORP-turbidity meter (the QED MP20) was used for specific conductance, pH, temperature, DO, ORP, and turbidity measurements. Turbidity measurements also were made with a digital readout turbidity meter (e.g., Hach 2100P). A photoionization detector (PID) was used to measure organic vapor measurements (headspace) inside the well immediately after opening the well caps. Equipment used to measure field parameters was maintained and calibrated daily according to the manufacturer's specifications.

2.1.1.4 Depth to Water Measurement

Depth to groundwater was measured at monitoring wells immediately prior to well purging and sampling activities to establish a static water level. Water levels were measured with a decontaminated electronic water level indicator (sounder) to the nearest 0.01 foot. Water levels also were measured at regular intervals during purging activities to ensure a constant drawdown was maintained during pumping. A final water level was recorded after sample collection. The reference point for water level measurements was the top of the casing.

2.1.2 Laboratory Assignments and Sample Analysis

The EPA Region 9 Laboratory, in Richmond, California, provided and coordinated the analytical support for the routine groundwater sampling at the Omega Site. Select laboratories were contracted by the EPA Region 9 Laboratory, as part of its Contract Laboratory Program (CLP), to assist with the analysis of groundwater samples. The contracted laboratories include the following:

- Shealy Environmental Services of West Columbia, South Carolina
- Ceimic of Narragansett, Rhode Island
- Sentinel of Huntsville, Alabama
- A4 Scientific of The Woodlands, Texas
- Bonner Analytical Testing of Hattiesburg, Missouri

Other non-CLP laboratories subcontracted by the United States Army Corps of Engineers (USACE) include the following:

- Severn Trent Laboratory (STL) of West Sacramento, California
- Applied P & Ch Laboratory (APCL) of Chino, California
- Test America of Irvine, California

MWH of Monrovia, California, and EMAX of Torrance, California, were contracted directly by CH2M HILL for the analysis of NDMA, COD, and hexavalent chromium during the February 2004 sampling event. A summary of the analytical parameters and assigned laboratories is provided in Table 2-5. Chain-of-custody forms are provided in Appendix C.

A detailed discussion of the analytical methods, bottle requirements, and hold-times for routine groundwater sampling activities is provided in the planning documents for Omega. All groundwater samples were analyzed using EPA-approved methods.

Analytical methods, as presented in the QAPP, are as follows:

- VOCs – EPA Method 524.2 or CLP Method SOM01.1
- SVOCs (plus 1,4-dioxane) – EPA Method 8270C or CLP Method SOM01.1
- NDMA – Modified EPA Method 1625
- Perchlorate – EPA Method 314
- Hexavalent Chromium – EPA Method 218.6
- 1,2,3-TCP – Method and QA/QC followed the California state guidance to achieve the regulatory limit of 0.005 micrograms per liter (µg/L)

- Metals (dissolved) plus boron and silica – EPA Methods 200.7, 200.8, and 245.1/CLP Method ILM05.3
- Cyanide – EPA Method 335.4
- TKN – EPA Method 351.2
- Ammonia – EPA Method 350.2
- Total Phosphorus – EPA Method 365.4
- TDS – EPA Method 160.1
- Alkalinity – EPA Method 2320B
- Bicarbonate – SM 2320B
- TOC – EPA Method 415.1
- BOD – EPA Method 405.1
- COD – EPA Method 410.1
- Anions (bromide, chloride, fluoride, nitrate-N, nitrite-N, orthophosphate-P, total sulfate) – EPA Method 300.0

2.2 Pre-Field Activities for Additional Fieldwork

The following sections describe activities that were performed prior to the start of the field investigation.

2.2.1 Permitting and Private Access Agreements

CH2M HILL assisted EPA with coordination of the efforts to obtain the well drilling permits required by local agencies for installation of groundwater monitoring wells, soil gas probes, and HydroPunch® borings. The wells and soil borings are located in the cities of Whittier, Santa Fe Springs, and Norwalk, California. CH2M HILL coordinated with each city to (1) gain public acceptance of the field activities, (2) notify nearby residents of the upcoming activities, and (3) create adequate traffic and noise control systems at each site. Permit fees were waived by all cities due to EPA's exemption from paying permit fees per Superfund regulations. Site location maps and excavation permit applications were provided to the cities prior to the implementation of the fieldwork. Permits were not obtained from the LACDHS, also due to EPA's exemption under Superfund regulations.

Access agreements were obtained for each well and soil boring located on private property. Agreements were signed by EPA and the property owner(s), and in some instances by CH2M HILL. No city or county permits or permitting fees were required for wells and soil borings located on private property.

2.2.2 Utility Clearance

CH2M HILL contacted Underground Service Alert (USA), a utility notification service, at least 72 hours prior to initiation of drilling. USA notified the appropriate utility companies and provided CH2M HILL with a Dig Alert permit. A geophysical utility locating subcontractor also was used to confirm that subsurface structures or utilities were not present beneath the proposed well or soil boring locations. In addition, the upper 5 feet of each location was hand-augered to detect and avoid any subsurface features not previously identified by USA or the geophysical utility subcontractor. No subsurface or aboveground utilities were disturbed during the investigation.

2.3 HydroPunch® Sampling for Well Placement

HydroPunch® groundwater sampling was conducted to assist with the placement of wells MW27, MW28, MW29, and MW30. The results of the sampling also were used to characterize the downgradient extent of contamination in the shallow aquifer. Gregg Drilling and Testing, of Signal Hill, California, was retained as the subcontractor for the HydroPunch® sampling. A total of 53 temporary soil boring locations in the cities of Santa Fe Springs and Norwalk were necessary for final well placement. Soil boring depths ranged between approximately 35 and 120 feet below ground surface (bgs).

2.3.1 General Approach

HydroPunch® samples were collected from temporary soil borings advanced with a 25-ton truck-mounted CPT rig. The HydroPunch® is designed to collect a single-point sample in a single direct-push hole with one probe entry. The HydroPunch® is essentially a temporary well system consisting of a steel cone-shaped drive tip and slotted polyvinyl chloride (PVC) well screen (screen-point sampler). When the desired groundwater sampling depth is reached, a hollow push rod with an enclosed 5-foot-long screen and sampler is driven into the native materials in advance of the borehole. The sampler is then drawn upward approximately 3 feet, exposing the screen of the sampler directly to the formation water. The steel tip and PVC well screen are left in the boring after each sample is collected.

A nominal 0.5-inch-diameter stainless-steel bailer, tied to a polyethylene string, was lowered into the hollow push rods to collect groundwater samples. After pulling the bailer out of the push rods, groundwater was poured directly from the bailer into four 40-milliliter (mL) volatile organic analysis (VOA) vials pre-preserved with hydrochloric acid (HCL). Samples were immediately packaged and stored in coolers until shipment. HydroPunch® samples, for VOC analysis, were shipped to Datachem Laboratories, Inc. (Datachem), of Salt Lake City, Utah. Datachem served as a contract laboratory to the EPA Region 9 Laboratory. EPA's CLP SOW Method SOM01.1 with select ion mode (SIM) was used for VOC and 1,4-dioxane analyses.

An attempt was made to collect two discrete groundwater samples at each boring location. Generally, one sample was collected immediately below the water table, and one sample was collected approximately 10 feet below the water table. Only one sample was collected if refusal was encountered at the deeper depth, or if refusal was expected to be encountered at the deeper sample depth. Two discrete samples were attempted at each location to increase

the likelihood of detecting contamination; historical single-depth discrete sampling at OU2 provided somewhat inconsistent results because some samples missed high VOC concentrations.

After HydroPunch® sampling was completed, each soil boring was plugged to land surface with 5 percent bentonite cement. The analytical results for the discrete sampling are discussed in detail in Section 5.

2.3.2 Well MW27 Placement

Well MW27 was installed to monitor the vertical extent of contamination in an area of moderate to high VOCs further downgradient of the source area. Seven soil borings were used to determine the placement of this well. The initial four borings (HP27-2 to HP27-5) were installed along Lakeland Boulevard between January 25 and February 15, 2007. These borings were spaced approximately 250 feet apart (Figure 2-2). Two discrete groundwater samples were collected in each boring. The shallow samples ranged between 87 and 95 feet bgs; the deeper samples were between 97 and 105 feet bgs. The depth to water in this area is approximately 80 feet bgs.

After a review of the initial data and taking into account the logistical constraints along Lakeland Boulevard, well MW27 was sited approximately 2,700 feet north, near the intersection of Clark Street and Norwalk Boulevard. Additional soil borings (HP27-6 to HP27-9) were installed along Clark Street on March 13 and 14, 2007, to finalize the placement of well MW27. The borings were spaced approximately 200 feet apart (Figure 2-2). An attempt was made to collect two discrete groundwater samples per location. Refusal was encountered during the collection of the deeper samples in borings HP27-6, HP27-7, and HP27-9; therefore, only one discrete sample was collected at these locations. Two discrete samples were collected from HP27-9. This included samples at 89.5 feet bgs and 98 feet bgs.

Analytical data for samples collected along Clark Street indicate that the highest concentrations of VOCs in this area are present immediately south of Norwalk Boulevard near HP27-7. Maximum PCE and TCE concentrations at HP27-7 were 200 and 100 micrograms per liter ($\mu\text{g/L}$), respectively. Based on these results, well MW27 was sited at this location.

2.3.3 Well MW28 Placement

Well MW28 was installed to monitor the western extent of the contaminant plume near the downgradient area. Five soil borings (HP28-1 to HP28-5) were installed along Lakeland Boulevard to site this well. These borings were installed between January 22 and January 25, 2007, and were spaced approximately 500 feet apart (Figure 2-3). Two discrete groundwater samples were collected at HP28-1, HP28-2, HP28-4, and HP28-5. Refusal was encountered at HP28-3 during the collection of the deeper sample; therefore, only one groundwater sample was collected at this location. Shallow discrete samples were collected at 90 feet bgs. The deeper samples ranged between 92 and 100 feet bgs.

Analytical data for the HP28 samples indicate that the western extent of the contaminant plume lies near the intersection of Pioneer Avenue and Lakeland Boulevard. PCE and TCE concentrations were generally less than the MCL of 5 $\mu\text{g/L}$. Based on the results, it was

decided to install well MW-28 in the southwest corner of Little Lake Park, which is owned by the city of Santa Fe Springs.

2.3.4 Wells MW29 and MW30 Placement

The purpose of the downgradient monitoring well(s) is to monitor the lateral extent of the contaminant plume in the shallow aquifer, typically where VOC concentrations are near the MCL (5 µg/L for PCE and TCE). Determination of monitoring well placement was assisted by a series of HydroPunch® sampling events.

The initial phase of HydroPunch® sampling indicated a more widespread contamination and two distinct lobes of contamination; one extending directly south beneath Norwalk Boulevard toward Imperial Avenue and one extending southeast of Norwalk Boulevard near its intersection with Allard Street. A total of four rounds of sampling was performed to gain insight regarding PCE/TCE distributions in this area and to finalize the placement of monitoring wells.

After a thorough review of the HydroPunch® sampling data, well MW29 was installed near the intersection of Gettysburg Drive and Norwalk Boulevard, and well MW30 was installed at the east end of Civic Center Drive to monitor the south and southeast lobes of the downgradient plume, respectively.

A more detailed discussion of the HydroPunch® sample results is presented in Section 5.

2.4 Monitoring Well Installation

CH2M HILL constructed several new groundwater monitoring wells in OU2 to characterize the vertical and lateral extent of the groundwater contaminant plume. These include four single-screen wells (MW23A, MW28, MW29, and MW30) and four multiple-screen (nested) monitoring wells (MW24, MW25, MW26, and MW27). A discussion of the well installation methodology is presented below.

Figure 2-1 shows the locations of all EPA and OPOG monitoring wells. The locations for wells MW23A, MW24, MW25, and MW26 slightly deviate from their originally proposed locations, as presented in the FSP Addendum (CH2M HILL, July 2006). This is due, in part, to property access agreement issues or logistical reasons (e.g., drilling rig access, power line hazards, underground utilities, etc.). The locations of wells MW27, MW28, MW29, and MW30 are based on the HydroPunch® sampling results as discussed above in the previous subsection.

2.4.1 Multiple-Screen Monitoring Wells

Water Development Corporation (WDC), of Montclair, California, drilled boreholes for installation of wells MW24, MW25, MW26, and MW27. Fieldwork started on February 19, 2007, at well MW26. Wells MW24, MW25, MW26, and MW27 were drilled using the direct-(mud)-rotary technique and a nominal 14- or 16-inch-diameter drill bit.

Prior to drilling, new heavyweight plastic sheeting was placed beneath the drill rig to prevent motor oil, compressor and hydraulic fluids, or other products from contaminating the surrounding asphalt and soils. Drilling equipment was thoroughly cleaned to ensure

that contaminants were not transported from one sampling location to another. All drilling equipment (that is, casing, drill stem, and sampling rods) used downhole were steam cleaned prior to use.

Drilling mud was used to prevent the collapse of boreholes and to remove cuttings from the boreholes. Drilling mud reduces the possibility of cross-contamination of groundwater zones because the mud invades the formation along the borehole walls, forming a low-permeability mud cake. The mud is removed later from the borehole during well development. To prevent collapse of the borehole, the drilling mud properties were monitored and maintained, and the mud generally was kept circulating throughout the borehole. Drilling mud properties were monitored and maintained by WDC, until the well casing was ready to be installed.

Drilling mud consisted of bentonite and water. No drilling additives were used at any of the wells. Water used for drilling mud was obtained from fire hydrants owned by the cities of Whittier and Santa Fe Springs. WDC obtained the required permits and water meters to access the water from the hydrants. WDC transferred hydrant water to their flat-bed water truck for storage until mud-rotary drilling commenced. CH2M HILL collected samples from WDC's water truck to ensure that no contaminants were introduced into the monitoring wells during drilling. Water truck samples were collected during construction of wells MW24, MW26, and MW27. Sample containers included four 40-mL VOA vials, pre-preserved with HCL. The well MW24 water truck sample was submitted to EPA Region 9 Laboratory for VOC analysis using EPA Method 524.2. Well MW26 and MW27 water truck samples were submitted to Datachem for VOC analysis using CLP Method SOM01.1 with SIM.

Table 2-6 presents a summary of detections for samples collected from WDC's water truck. Detections for bromodichloromethane, bromoform, and dibromomethane were reported in all three water samples. Detections ranged between 0.3J $\mu\text{g/L}$ and 12 $\mu\text{g/L}$ for bromodichloromethane, 4.9 $\mu\text{g/L}$ and 13J $\mu\text{g/L}$ for bromoform, and 1.3 $\mu\text{g/L}$ and 11 $\mu\text{g/L}$ for dibromomethane. An isolated detection of chloroform (9.1 $\mu\text{g/L}$) was reported in the well MW27 sample. Bromodichloromethane, bromoform, dibromomethane, and chloroform are part of a class of compounds known as trihalomethanes (THMs), common by-products formed during chlorination (treatment) of drinking water to kill bacteria. The maximum combined concentration of THMs (45.1 $\mu\text{g/L}$) is less than the most stringent regulatory action level of 80 $\mu\text{g/L}$ (EPA Primary MCL for total THMs). Other isolated detections include 1,4-dioxane (3.4J $\mu\text{g/L}$) and TCE (0.2J $\mu\text{g/L}$), both of which were reported in the well MW26 water truck sample. The 1,4-dioxane detection slightly exceeded the California Department of Health Services (CDHS) notification level (NL) of 3 $\mu\text{g/L}$. The TCE detection of 0.2J $\mu\text{g/L}$ was below the California primary MCL of 5 $\mu\text{g/L}$. The low concentrations of 1,4-dioxane and TCE in the well MW26 water truck sample could have been a result of cross-contamination, from an unknown source, inside the water truck storage tank or at the tank discharge point. Since monitoring well MW26 was fully developed after well completion, it is unlikely that any water used during well construction would have impacted background water quality.

2.4.1.1 Lithologic Logging

The field geologist collected and logged drill cuttings from the boreholes at 10-foot intervals, or at significant changes in borehole lithology. Approximately 1 gallon of drill cuttings was

collected from the drilling rig “mud shaker” using a fine mesh screen attached to a broomstick handle. The cuttings were then placed in a 200 millimeter (mm) sieve pan and rinsed in a 5-gallon bucket filled with potable water. The field geologist then visually inspected the cuttings for Unified Soil Classification System (USCS) soil type, color, moisture content, relative density or consistency, grain sizes and relative percentages, angularity, mineralogy, weathering, or other descriptors. Drill cuttings were later placed in labeled, plastic, fishing tackle boxes for review of the visual description. Boring logs are presented in Appendix A.1.

2.4.1.2 Discrete-Depth Sampling

In situ, discrete-depth soil and groundwater samples were collected during drilling of well MW24 using a Maxiprobe Simulprobe® Sampling System (Simulprobe) to identify zones of groundwater contamination. The purpose of the probe is to collect soil and groundwater samples concurrently while advancing the well borehole. The Simulprobe consists of three primary sections: the cutting shoe and screen-coupling assembly, the soil core barrel, and the water storage canister. Together, the Simulprobe is approximately 4 feet long with an outside diameter (OD) of 3.38 inches.

Prior to sampling, all parts of the Simulprobe were washed with nonphosphate detergent (Alconox) and triple rinsed. Then the Simulprobe was assembled and lowered to the bottom of the borehole. The Simulprobe was pounded approximately 2 to 3 feet into the soil, allowing for the collection of a soil sample and positioning the device for collection of a groundwater sample.

Simulprobe samples were collected beginning at 10 feet below the water table (approximately 50 feet bgs) to the total depth of the boring (200 feet bgs) with the intent to sample every 10 feet. The actual sample depths deviated slightly and were selected based on encountered lithology with the goal of sampling permeable (coarse-grained) units. Soil samples were used for lithologic description by the field geologist. Groundwater samples were used to assist with the selection of the well screen intervals. An attempt was made to collect groundwater samples at 10-foot intervals; however, groundwater recovery was only achieved at 60, 80, 140, and 155 feet bgs. This was due, in part, to mechanical problems with the Simulprobe sampler, or to the low permeability of the lithologic unit sampled. Groundwater was poured directly from the sampler into three 40-mL VOA vials, pre-preserved with HCL. Samples were packaged, stored in an iced cooler, then shipped to the EPA Region 9 Laboratory for VOC analysis (EPA Method 524.2). Table 2-7 provides a summary of VOC detections for the discrete-depth samples.

2.4.1.3 Geophysical Logging

Pacific Surveys of Claremont, California, a subcontractor to WDC, performed geophysical logging of each mud-rotary-drilled borehole prior to the installation of wells MW24, MW25, MW26, and MW27. The results from the geophysical logging were used in conjunction with lithological logs to aid in selection of the well screen intervals. Logs performed include electric (16- and 64-inch normal resistivity, spontaneous potential, guard resistivity), gamma ray, and caliper. Electronic copies of the geophysical logs (in image and ASCII format) can be found in Appendix A.2.

Electric logs incorporated four separate measurements: spontaneous potential (SP), short normal resistivity (SNR 16-inch normal), long normal resistivity (LNR 64-inch normal), and single-point (guard) resistivity. In general, resistance increases with increasing grain size and decreases with increasing borehole diameter, fracture density, and dissolved solids concentration in groundwater. Electrical logs are useful in the determination of lithology, water quality, and location of fracture zones.

SP logs record the voltage between the logging tool electrodes; this voltage is a measure of natural electric potential that develops between the borehole fluid and surrounding formation.

SNR and LNR logs record the electrical resistivity of the borehole environment and surrounding rocks and water as measured by variably spaced potential electrodes on the logging probe. Resistivity logging uses a source of alternating current to induce electric potential in the formation-borehole fluid system via current electrodes. Typical spacing for potential electrodes is 16 inches for SNR and 64 inches for LNR. Normal resistivity logs are affected by bed thickness, borehole diameter, and borehole fluid. Guard resistivity records the electrical resistivity of the borehole and surrounding formation and water with a focused beam of electrical current. This provides a higher resolution of the contacts between the soil layers than that provided by the SP, SNR, and LNR logs.

Gamma ray logs record the amount of natural gamma radiation emitted by the rocks surrounding the borehole. The most significant naturally occurring sources of gamma radiation are potassium-40 and daughter products of the uranium- and thorium-decay series. Clay- and shale-bearing rocks commonly emit relatively high gamma radiation because they include weathering products of potassium feldspar and mica and tend to concentrate uranium and thorium by ion adsorption and exchange. Layers of volcanic ash are distinguished by high gamma emissions. High potassium feldspar content in arcose sands derived from weathered granitic rocks can mask the signature of clays on a gamma log.

Caliper logs record borehole diameter using three arms. Changes in borehole diameter are related to well construction, such as casing or drilling bit size, and to fracturing or caving along the borehole wall. Because borehole diameter commonly affects other geophysical logging method responses, the caliper log is useful in the analysis of other geophysical logs. In addition, caliper data can be used to evaluate wash-out areas, and to provide total and annular volumes for gravel and cement volume calculations.

2.4.1.4 Well Construction

After reviewing the geophysical logs and designing the well, the drilling mud was thinned back to allow for proper installation of the well casing, screen, and annular materials. Wells were constructed using either 2-inch or 4-inch OD, Schedule 80, threaded PVC casing; 0.020-inch slot, Schedule 80, threaded PVC well screen; and 5 feet of blank PVC casing to serve as a well sump. Wells MW24, MW25, and MW27 were quadruple-nested, with two 2-inch-diameter casings and two 4-inch-diameter casings completed in a single borehole. Well MW26 also was quadruple-nested, but with three 2-inch-diameter casings and one 4-inch-diameter casing completed in a single borehole.

Concentric stainless-steel centralizers were installed at the top and bottom of each well screen to assist with maintaining a minimum of 2 inches of annular space between each well

casing. Centralizers were not installed shallower than the top of each well screen to avoid obstruction of the downhole tremie pipe used to install the annular materials.

After the well casings and screens were lowered to the proper depths, a nominal 2-inch-diameter steel tremie pipe was lowered to approximately 5 to 10 feet below the top of the deepest well screen for the installation of the filter pack. A cyclone pump was used to mix and pump all annular materials through the tremie pipe. A weighted measuring tape was used to tag annular materials during placement. The tremie pipe was lifted sequentially during placement of each layer of filter pack and annular seal.

The annular space of the borehole surrounding each screen was backfilled with Lone Star Monterey Sand (No. 3 or No. 2/12 grade). Filter pack selection was based on the well construction design of existing EPA monitoring wells, lithologic logs and visual observation of drilling cuttings. Filter pack was placed around each screen zone, generally extending 3 to 5 feet above and below each screen. Prior to installing the annular seals, the screens were swabbed with a bailer or surge-block device to facilitate the settling of the filter pack.

Medium bentonite chips (5-foot minimum thickness) were placed above the top of the filter packs to provide an annular seal between each screen interval. A 1:1 mixture (by dry volume) of granular bentonite and No. 3 Monterey sand were placed above the bentonite chip seal to provide an additional seal between screen intervals. The remaining annular space of the borehole above the uppermost screen was backfilled with Portland Type II 5 percent bentonite cement to the ground surface.

Well construction details for wells MW24, MW25, MW26, and MW27 are presented in Table 2-1.

2.4.2 Single-Screen Monitoring Wells

Prosonic, Inc. (acquired by Boart Longyear later in 2007), of Santa Fe Springs, California, drilled 8-inch-diameter boreholes for installation of wells MW23A, MW28, MW29, and MW30. These 4-inch-diameter wells were drilled using roto-sonic (sonic) drilling methods. The sonic drilling method employs the use of a high-frequency mechanical vibration to advance the drill string through unconsolidated, and to a limited extent, consolidated materials. The sonic rig uses an oscillator, or head, with eccentric weights driven by hydraulic motors, to generate high sinusoidal force in a rotating drill pipe. The frequency of vibration of the core bit can be varied to allow optimum penetration of subsurface materials. Sonic drilling can use water as a drilling fluid, if necessary.

Sonic drilling was conducted using a nominal 7-inch-diameter inner casing (core barrel) equipped with a cutting shoe, followed by an 8-inch-diameter outer casing. After advancing the core barrel at 10-foot intervals, the core barrel was removed from the borehole, and the soil core was removed and transferred to the field geologist for lithologic description. The core barrel was placed back into the borehole and advanced another 10 feet. An additional 10 feet of outer casing was added to the outer casing that was below ground and then advanced to meet the bottom of the core barrel. This process was continued until the total depth was reached. Sonic drilling does not produce soil cuttings, but may generate waste water by removing groundwater with the core barrel.

2.4.2.1 Lithologic Logging

The field geologist collected and logged the sample cores continuously during advancement of the borehole. The field geologist visually inspected the cores for USCS soil type, color, moisture content, relative density or consistency, grain sizes and relative percentages, angularity, mineralogy, weathering, or other descriptors. After logging the soil, samples were placed in labeled, plastic, fishing tackle boxes for long-term storage. Boring logs for wells MW23A, MW28, MW29, and MW30 are presented in Appendix A.1.

An organic vapor analyzer (OVA) was used for select soil samples during lithologic logging. A MiniRAE 2000 PID with 10.6-electron-volt (eV) lamp, was used for OVA measurements. The PID was calibrated daily, using 100 parts per million (ppm) isobutylene, according to the manufacturer's specifications. For field screening, a soil sample was placed and sealed in a resealable plastic bag before being disaggregated. After the disaggregated soil sample was allowed to volatilize for approximately 5 minutes in the bag, the bag was pierced with the head of the PID, and the concentration of VOCs in the headspace of the plastic bag was measured and recorded on the boring log.

2.4.2.2 Well Construction

Single-screen wells were constructed using 4-inch-OD, Schedule 80, threaded PVC casing; 0.020-inch-slot, Schedule 80, threaded PVC well screen; and 5 feet of blank PVC casing to serve as a well sump. Centralizer and annular material installation generally followed the same procedures used to install the nested monitoring wells (see Section 2.4.1.4) except that no drilling mud was used. Well construction details for wells MW23A, MW28, MW29, and MW30 are presented in Table 2-1.

2.4.3 Well Development

Initial well development activities included a combination of bailing and swabbing the entire length of each well screen. At times during swabbing, the swab assembly was raised and lowered to create a simultaneous surging action of water adjacent to the well screen. After a reduction of sediment and turbidity was observed (and all drilling mud was removed from the nested wells), a 2-inch-diameter submersible pump was lowered to the screen interval, and the interval was pumped until it was clean (that is, free of color and sediment, and low turbidity). Pumping rates varied between 2-inch- and 4-inch-diameter wells, but generally ranged from 1 to 5 gallons per minute (gpm). After pumping the well clean, the pump was removed from the well, and the swab assembly was then lowered to the well screen for additional surging. This process was repeated until the water was free of sediment and turbidity levels were below 10 nephelometric turbidity units (NTUs).

Field parameters (i.e., turbidity, pH, EC, DO, ORP, and temperature) were measured during well development to determine the state of development. Well screen development generally was considered complete when turbidity measured less than 10 NTUs, and all other field parameters indicated a stable trend. Well development logs containing field parameter measurements are included in Appendix A.3.

2.4.4 Dedicated Bladder Pump Installation

Dedicated bladder pumps, manufactured by QED Environmental Systems (QED), were installed in new EPA monitoring wells MW23A and MW24 to MW30. Design details and

pump specifications are included in Appendix A.4. Two types of pump designs were used: Well System A and Well System L. Well System A pumps include a QED Model T1200M bladder pump equipped with a bottom-attached pump inlet screen. The pump body is constructed of stainless steel. Premeasured and cut polyethylene tubing is attached to each pump for air injection and water discharge. The tubing is attached to hose-barbs on a recessed well cup (which sits inside the well casing). All tubing attachments were tested by the manufacturer for tightness. Pumps were installed using System A in wells MW23A, MW24A, MW24B, MW25A, MW25B, MW26A, MW26B, MW26C, MW27A, MW27B, MW28, MW29, and MW30.

Well System L uses a similar design with one exception – the pump inlet is attached to the bottom of the pump via premeasured lengths of extension tubing. This setup was used where there was over 100 feet of water column above the proposed inlet depth. Using this design, the pump can be set at a shallower depth, thus requiring less gas pressure to operate. This allows faster discharge rates and uses less gas. Wells equipped with System L type pumps include MW24C, MW24D, MW25C, MW25D, MW26D, MW27C, and MW27D.

For shallow wells, where the water table is near or within the well-screen interval, the pump inlets were generally installed 5 feet above the bottom of the screen. For deeper wells, where the well screens are totally submerged, the pump inlets were installed between 5 feet and 10 feet above the bottom of the screen.

Prior to the installation of the pumps, CH2M HILL staff measured the depth to water and total depth in each of the wells. The pumps were installed on July 5, 2007, under the supervision of Mr. David Corder of QED.

2.5 Surveying

All HydroPunch® soil boring locations were surveyed by CH2M HILL staff using a Trimble® GeoXT™ hand-held global positioning system (GPS). Boring locations were surveyed in Universal Transverse Mercator (UTM) meters, North American Datum (NAD) 83 Zone 11. Survey results are presented in Appendix A.5.

An engineering survey of new well locations and elevations was conducted on June 13, 2007, by Calvada Surveyors, Inc. (Calvada), of Corona, California. Wells MW1 to MW11 also were surveyed on June 15, 2007, to verify the accuracy of the previous survey conducted by Weston in 2001. Calvada is a licensed land surveyor in the state of California. Well locations were surveyed in California State Plane, NAD 83, Zone 5, and wellhead reference point elevations in National Geodetic Vertical Datum (NGVD) 88 (to the nearest 0.01 foot). National Geodetic Survey Monument DYHS (Downey High School) was used as a benchmark for the survey. A copy of Calvada's survey report is included in Appendix A.5.

2.6 Aquifer Testing

The objective of the aquifer testing at Omega was to estimate aquifer properties that can be used in numerical modeling and calculations in support of remedial alternatives analysis in the future FS. Slug testing and step-drawdown testing were included as part of the aquifer testing program. The aquifer testing included slug tests and pumping tests. Slug tests are

relatively fast and result in a minimum amount of waste generated; they were performed on all Omega wells at OU2 to characterize the distribution of hydraulic conductivity. The more expensive pumping tests were performed at selected well locations only.

2.6.1 Slug Tests

Slug testing is a type of aquifer test where water or an object that displaces water is added or removed from a well, the change in hydraulic head is monitored through time, and a mathematical model is fitted to the field data to determine the near-well aquifer characteristics. Slug testing data are generally representative of a much smaller volume of aquifer materials in comparison to the volume of representative aquifer materials that can be assessed using data from pumping tests.

Slugs were constructed of 1.30-inch and 2.36-inch-OD Schedule 40 threaded PVC casing with prefabricated lengths of 5 feet, 10 feet, and 15 feet. A 3-foot-long steel rebar was placed inside each of the slugs to offset buoyancy effects from the air trapped inside of the slugs. PVC end caps were threaded to both ends to prevent water from leaking into the slugs. The bottom caps were pointed to prevent the water hammer effect when the slug is dropped. A stainless-steel eyebolt screw was installed on the top end cap to provide a connection between the slug and polyethylene rope that was used to raise and lower the slugs.

Prior to initiating slug testing, a submersible pressure transducer was installed in each well to monitor pressure changes over time. A transducer rated at 20 pounds per square inch (psi) was lowered between 10 and 30 feet below the static depth to water in each well. The final depth of the transducer was dependent on the total depth of the well in relation to static depth to water. The transducer cable was connected to an In Situ Hermit® 3000 data logger, capable of recording pressure readings on a logarithmic scale.

The general procedure for conducting a slug test is as follows:

- Measure static depth to water with an electronic water level sounding device.
- Install pressure transducer to 10 to 30 feet below static depth to water.
- Lower the PVC slug to approximately 5 feet above the static depth to water.
- Start recording pressure readings with the Hermit data logger using the logarithmic programming mode.
- Drop the slug so that the top of the slug is submerged approximately 5 feet below the static depth to water.
- Continue recording pressure data until water levels have stabilized.
- Stop recording pressure data for falling-head test (slug submerged into water, or slug-in test).
- Prepare for rising-head test (slug removed from the water, or slug-out test).
- Repeat start recording pressure readings with the Hermit data logger using the logarithmic programming mode.
- Pull slug out until the bottom of the slug is approximately 5 feet above the static depth to water.

- Continue recording pressure data until water levels have stabilized.
- Review data and repeat steps above if necessary. The tests were generally repeated twice (for a total of two slug-in and two slug-out tests) to ensure test repeatability and assess data noise.

The slugs, transducers, and transducer cables were decontaminated with Alconox and deionized water between wells to reduce the potential for cross-contamination. In addition, the field crew typically conducted slug tests in order of least contaminated to most contaminated wells during each day of testing. The dry portion of the polyethylene rope used to raise and lower the slugs was reused between wells. New rope was typically used at the beginning of each day of testing.

Slug testing was conducted in the following four phases at the Omega Site:

- **Phase 1** – conducted between May 15 and May 24, 2006, and included tests in wells OW3B, OW4A, OW4B, OW5, OW6, OW7, OW8B, MW1A, MW1B, MW2, MW3, MW4A, MW4B, MW4C, MW5, MW6, MW7, MW8A, MW8B, MW8C, MW8D, MW9A, MW9B, MW10, MW11, MW13B, MW15, MW16A, MW18A, MW18B, MW18C, MW23B, MW23C, and MW23D.
- **Phase 2** – conducted between August 7 and August 9, 2006, and included tests in wells MW12, MW14, MW16B, MW16C, MW17A, MW17B, MW17C, MW20A, MW20B, MW20C, MW21, and MW22.
- **Phase 3** – conducted between May 1 and May 5, 2007, and included tests in wells MW25A, MW25B, MW25C, MW25D, MW26A, MW26B, MW26C, MW26D, MW27A, MW27B, MW27C, and MW27D.
- **Phase 4** – conducted between June 15 and June 18, 2007, and included wells MW23A, MW24A, MW24B, MW24C, MW24D, MW28, MW29, and MW30.

An average of two rising-head and two falling-head slug tests were conducted in each well. The exact number of tests was dependent on aquifer response and quality of recorded data. A summary of rising and falling slug tests conducted during all phases of the investigation is presented in Table 2-8. A discussion of the results is presented in Section 4.

2.6.2 Pumping Tests

Pumping tests were performed on selected wells to provide estimates of aquifer properties representative of a larger aquifer volume than the results from the slug tests and to assess hydraulic communication between aquifer units. The tests also provided information on well yield for the future FS. The pumping rate was increased in a step-wise fashion during each test to avoid over-pumping the test wells (a pumping well would go dry at a discharge rate that is too high), estimate the well loss, and estimate the well specific capacity. The step-wise test pumping eliminated the need for a preliminary test to estimate the well yield (as is usually done prior to a constant-rate pumping test) and resulted in a smaller volume of wastewater compared to that from a constant-rate test at high discharge rate.

A large-scale pumping test was planned (CH2M HILL, 2006) to investigate the hydraulic response in the Omega wells to pumping from production well 2S/11W-30R3 (Santa Fe

Springs No. 1). The test was not performed because it would have required interrupting the water supply for the city of Santa Fe Springs.

2.6.2.1 Extraction Well

Well EW1 was installed as an extraction well for a pumping test conducted to help characterize the aquifer properties and hydraulic communication between aquifer units near well MW8, upgradient of production well SFS#1 (Weston, 2002; CH2M HILL, 2004).

Pumping was initiated on November 20, 2006.

Prior to testing, a 30-psi rated pressure transducer (In-Situ Level TROLL® 700 Series) was installed in the pumping well approximately 35 to 45 feet below static depth to water. Water levels were programmed to be recorded at 30-second intervals in well EW1. Pressure transducers also were installed in nearby wells MW8A, MW8B, MW8C, and MW8D. Water levels were programmed to be recorded at 5-minute intervals in these wells. The purpose of the transducers was to record water levels during background (static), pumping, and recovery periods. The collection of background data was initiated on November 17, 2006. Recovery data were collected until water levels stabilized to near background conditions. Manual depth-to-water readings were collected with a sounder to confirm the accuracy of the transducer data.

A 3-inch-diameter stainless-steel submersible pump was used for extracting groundwater. A 2-inch-diameter in-line digital flowmeter with totalizer was used to calculate flow rate measurements in units of gpm. In addition, a premeasured 5-gallon bucket was used to verify the digital flowmeter readings by recording the time required to fill 5 gallons. Totalizer measurements were collected before, during, and at the end of each test.

Six consecutively increasing pumping rates were maintained: 5, 8, 10, 11.9, 18, and 30 gpm. The first three rates were maintained for approximately 2 hours each; the fourth rate was maintained for 10 hours; the fifth rate was maintained for 6.8 hours; and the last rate was maintained for 1.9 hours. Extracted water was discharged directly to a 21,000-gallon Baker tank located immediately adjacent to the monitoring wells. Approximately 19,300 gallons of purge water was generated during the test.

2.6.2.2 Monitoring Wells

Step-drawdown pumping tests were conducted at monitoring wells MW23A, MW24A, MW24C, MW26A, MW26B, MW27A, MW27B, and MW30 between June 20 and July 2, 2007. Prior to testing, a 30-psi rated pressure transducer (In-Situ Level TROLL® 700 Series) was installed in the pumping wells to record water levels at 1-second intervals during background, pumping, and recovery periods. During the tests conducted at wells MW24, MW25, MW26, and MW27, pressure transducers were installed in at least two other wells completed in the same borehole. Observation well transducers were programmed to record water levels at one-minute intervals.

On June 19, 2007, one In-Situ BaroTROLL® was installed inside the vault of well MW8A to monitor atmospheric pressure changes during pumping and recovery periods of all tested wells. Barometric pressure readings were programmed to be recorded at 1-minute intervals. In addition, pressure transducers were installed in wells MW23C and MW23D to monitor background water levels at 1-minute intervals.

Either a 2-inch- or 3-inch-diameter stainless-steel submersible pump was used for extracting groundwater. A 2-inch-diameter in-line digital flowmeter with totalizer was used to calculate flow rate measurements. Totalizer and manual depth-to-water measurements were collected before, during, and at the end of each test.

The details of the step-drawdown pumping tests for all testing and monitoring wells are tabulated in Table 2-9.

2.7 Source Area Investigation

The OU2 plume extends over a large commercial-industrial area where past activities may have resulted in groundwater contamination. The distribution of contaminants characterized during EPA's investigations indicated the presence of sources of groundwater contamination in OU2 other than the former Omega facility. In addition, CH2M HILL conducted a file review to identify facilities that are potential sources of groundwater contamination. Investigations were conducted at such facilities, for which there was insufficient information to determine whether they have caused groundwater contamination.

Five commercial facilities were investigated to identify potential sources of VOC contamination other than the former Omega facility. These facilities were identified as potential VOC sources based on the distribution of VOCs in groundwater at OU2 and on the findings of the state and local agency file review. These include Site D, Site E, Earl Manufacturing, Site F, and the TCE Source at Whittier Boulevard (Figures 2-5 to 2-9). The general approach was to collect discrete groundwater samples from temporary soil borings positioned upgradient and downgradient of each suspected source area. A net increase of VOC concentrations, or a change in VOC composition downgradient of an investigated facility, would indicate that the facility is a likely source of groundwater contamination.

At least four downgradient soil borings were installed at each facility. In general, a 100-foot spacing was utilized. A smaller spacing of 50 feet was used at Site D so that at least four downgradient borings could be installed. An attempt was made to collect two discrete groundwater samples at each boring location: one sample immediately below the water table and one sample approximately 10 feet below the water table. Two sampling depths were attempted at each location to obtain a better characterization of contaminant distribution than single-depth discrete samples would allow. The sample identification of discrete samples includes the boring location followed by an "A" for the shallow depth (e.g., HPT-1A) or "B" for the deeper depth (e.g., HPT-1B).

CPTs also were implemented at some facilities to assist with the selection of discrete sampling intervals in areas with predominantly fine-grained sands and slow groundwater recharge. A description of CPT methodology is provided in Section 2.8.1.

Gregg Drilling and Testing, of Signal Hill, California, was retained as the subcontractor for conducting CPT and HydroPunch® sampling.

2.7.1 Site D, 8421 South Chetle Avenue, Santa Fe Springs, California

Site D is located at 8421 South Chetle Avenue, Santa Fe Springs, California, and is currently known as L.A. Pipe and Supply. This facility served as a transporter of dry cleaning waste (such as liquid PCE and solids contaminated with PCE) between 1996 and 2002. Wastes were typically transferred or loaded to other vehicles at the facility. No previous soil or groundwater data are available. Investigations were recommended based on the history of PCE storage at the facility and its location in an area of high VOC contamination (greater than 500 µg/L PCE).

HydroPunch® sampling at Site D was conducted between February 21 and 23, 2007. A total of five borings (HPT-1 to HPT-5) were installed as part of this investigation (Figure 2-5). Boring HPT-1 was installed along the north side of Chetle Avenue, in city of Santa Fe Springs right-of-way. HPT-1 served as an upgradient sampling point. Downgradient borings HPT-2 to HPT-5 were installed in a parking lot just south of Site D. The adjacent facility is known as Moranth Fabrication and is located at 8433 Chetle Avenue. The borings were spaced at approximately 50-foot intervals.

Two discrete groundwater samples were collected at 40 and 50 feet bgs at all boring locations. Field duplicate samples were collected during the collection of samples HPT-3B and HPT-5B. Samples were collected in four 40-mL VOA vials pre-preserved with HCL, then shipped to Datachem for VOC and 1,4-dioxane analysis (CLP Method SOM01.1 with SIM).

2.7.2 Site E, 12200 Los Nietos Road, Santa Fe Springs, California

Site E is located at 1200 Los Nietos Road, Santa Fe Springs, California. This facility served as a paint manufacturing company between 1953 and 2001; the company produced water- and solvent-based paints, and stored solvents (TCE) and other raw materials in both aboveground storage tanks (ASTs) and USTs. VOCs were detected in both soil and groundwater during a 1995 investigation. Some of the groundwater contamination found at this facility may have originated upgradient. However, because this facility is not located directly downgradient from a known source area, the historical facility data are an indication of a possible release of contamination.

HydroPunch® sampling near Site E was conducted on January 26, May 2, February 21, and February 23, 2007. A total of six borings (HPF-1 to HPF-6) were installed as part of this investigation (Figure 2-6). The two upgradient HydroPunch® borings (HPF-1 and HPF-2) were installed north of Los Nietos Road, in parking lots located at 12139 and 12207 Los Nietos Road, Santa Fe Springs. Downgradient soil borings (HPF-3 to HPF-6) were installed along Pike Street, immediately adjacent to the Triangle Distribution Company (12065 Pike Street), between February 21 and February 23, 2007. These borings were located on city of Santa Fe Springs right-of-way.

Discrete groundwater samples were collected at 77 and 87 feet bgs at upgradient borings HPF-1 and HPF-2. Discrete samples were collected at 80 and 90 feet bgs at borings HPF-3, HPF-4, and HPF-6. At HPF-5, discrete samples were collected at 75 and 85 feet bgs. Groundwater samples were collected in four 40-mL VOA vials pre-preserved with HCL, then shipped to Datachem for VOC and 1,4-dioxane analysis (CLP Method SOM01.1 with SIM).

2.7.3 Earl Manufacturing, 11862 Burke Street, Santa Fe Springs, California

Earl Manufacturing is located at 11862 Burke Street, Santa Fe Springs, California, and is currently known as FTR Associates. This facility also is located immediately south of Techni-Braze, a known source of VOC contamination. An onsite monitoring well, screened from 22 to 42 feet bgs, was installed near a former UST in 1999. Subsequent groundwater sampling revealed PCE and TCE concentrations in the shallow aquifer were 13,700 µg/L and 1,730 µg/L, respectively. The high concentrations of VOCs detected at this facility warranted further investigation.

A total of seven soil borings (HPE-1 to HPE-7) were installed as part of the Earl Manufacturing investigation (Figure 2-7). Borings HPE-1 and HPE-2 were installed on January 23, 2007, in a parking lot located just east of FTR Associates, and served as the upgradient sampling points. The parking lot is part of the Steven Label property, located at 11876 Burke Street. Downgradient borings HPE-3 to HPE-7 were installed on March 16 and March 19, 2007, in a parking lot located immediately south of FTR Associates. This parking lot is part of the business complex located at 8708 Dice Road.

Discrete groundwater samples were collected at 35 and 45 feet bgs at HPE-1 and HPE-2. Discrete samples were generally collected at 35 and 48 feet bgs at borings HPE-3 to HPE-7. The deeper sample at HPE-3 was collected at 52 feet bgs, primarily due to poor recharge at the initial target depth of 48 feet bgs. Groundwater samples were collected in four 40-mL VOA vials pre-preserved with HCL, then shipped to Datachem for VOC and 1,4-dioxane analysis (CLP Method SOM01.1 with SIM).

2.7.4 Site F, 8623 Dice Road, Santa Fe Springs, California

Site F is located at 8623 South Dice Road, Santa Fe Springs, California. This facility manufactures wire fasteners and has been in operation since 1964. In 1972, operations were expanded from manufacturing wire fasteners to include zinc plating. The facility consists of three buildings containing offices, a machine shop, a zinc plating area, and a warehouse. Violations for two sodium cyanide spills along Burke Street were reported in 1974 and 1978. A violation for the discharge of oil liquids to an adjacent culvert, west of the property, was reported in 1981. There are no onsite soil or groundwater data to confirm contamination from VOCs or metals at this facility.

HydroPunch® sampling near Site F was conducted between March 5 and 12, 2007, and on May 9, 2007. CPTs also were conducted at borings HPW-1 and HPW-6 to assist with the selection of discrete sampling intervals. The CPT was used to maximize the potential for sampling in zones with coarse-grained units because initial attempts to collect groundwater samples required long times for the sampler to fill with water. Electronic copies of the CPT logs are presented in Appendix A.6.

A total of 10 soil borings (HPW-1 to HPW-10) were installed as part of this investigation (Figure 2-8). The upgradient sample locations include HPW-1, HPW-2, HPW-9, and HPW-10. Discrete groundwater samples were collected at 50 and 70 feet bgs at HPW-1, 38 and 50 feet bgs at HPW-2, and 53 feet bgs at HPW-9 and HPW-10. A total of six soil borings (HPW-3 to HPW-8) were installed at locations downgradient of the facility. Of these, five soil borings (HPW-3 to HPW-7) were positioned approximately 100 feet apart along Burke Street in city of Santa Fe Springs right-of-way. The remaining downgradient

boring (HPW-8) was positioned along Westman Avenue, approximately 230 feet south of Site F. Discrete samples were collected at 35 and 50 feet at HPW-3, 40 and 50 feet bgs at HPW-4 and HPW-5, 45 and 53 feet bgs at HPW-6, 53 feet bgs at HPW-7, and 35 and 53 feet at HPW-8.

Due to slow groundwater recharge at this facility, groundwater in some direct-push rods was allowed to recharge overnight before collecting groundwater samples. This was accomplished by pushing the rods to the first sample depth, retracting the screen, then leaving the push rods in the ground overnight. The next morning, a bailer was lowered into the push rods for sample collection.

In addition to VOCs and 1,4-dioxane, hexavalent chromium and dissolved metals samples were collected during this investigation. Hexavalent chromium samples were bailed into a 250-mL polyethylene bottle. Metals samples were initially bailed into a clean 1 liter polyethylene bottle, then pumped through a 0.45-micron filter using a peristaltic pump, and finally transferred to a 1 liter polyethylene bottle pre-preserved with nitric acid. Metals samples were not collected in the shallow discrete sample at borings HPW-3, HPW-4, or HPW-5 due to insufficient sample volume. Samples collected for VOCs and 1,4-dioxane were submitted to Datachem for analysis using CLP Method SOM01.1 with SIM. Samples collected for dissolved metals were shipped to Ceimic for analysis using CLP Method ILM05.3. Hexavalent chromium samples were analyzed by Test America using EPA Method 218.6. Due to the 24-hour hold time restrictions on hexavalent chromium, a courier was assigned by Test America to transport samples on a daily basis.

2.7.5 TCE Source at Whittier Boulevard, in the Vicinity of Whittier Boulevard and Mar Vista Street, Whittier, California

The TCE source at Whittier Boulevard is located on the east side of Whittier Boulevard immediately north of Mar Vista Street. Several automotive repair and maintenance facilities currently occupy the northern parcel of the site. The former facility that occupied the northern parcel served as a furniture manufacturing company with a painting booth and dip tank located onsite. A preliminary environmental assessment was conducted at the site in September 1987 and a follow-up soil investigation was completed in October 1987. No groundwater investigation has been conducted at this former facility, and it is unclear when the business ceased operations. Further investigations near this facility were warranted based on the history of chemical usage, as well as the presence of relatively high TCE concentrations (greater than 100 µg/L) in groundwater immediately downgradient of the site.

The southern parcel consists of a dirt lot owned by the city of Whittier. The city plans to utilize this area as part of its Greenway Trail Project. The history of this parcel of land is currently unknown.

A total of 13 soil borings (HPA-1, HPA-6 to HPA-10, and HPA-12 to HPA-18) were installed as part of this investigation (Figure 2-9). Borings HPA-6 to HPA-10 were installed along a California Department of Transportation (Caltrans) greenbelt right-of-way between February 15 and 20, 2007. An access agreement with Caltrans was executed on January 21, 2007. On February 19, 2007, boring HPA-1 was installed in the city of Whittier street right-

of-way, near the intersection of Baldwin Place and the Whittier Boulevard frontage road. Borings HPA-1 and HPA-6 to HPA-10 served as downgradient sampling points.

Borings HPA-12 to HPA-18 were installed on March 21 and March 22, 2007. Borings HPA-12, HPA-13, HPA-14, and HPA-15 served as downgradient sampling points. Borings HPA-16, HPA-17, and HPA-18 served as upgradient sampling points. All borings are located in a dirt lot owned by the city of Whittier. The property address of the lot is 725 Whittier Square, Whittier, California.

CPTs also were conducted at borings HPA-1 and HPA-8 to assist with the selection of discrete sampling intervals. Electronic copies of the CPT logs are included in Appendix A.6. Due to slow groundwater recharge in the study area, groundwater inside the direct-push rods was allowed to recharge overnight before collecting groundwater samples. Only one discrete sample was collected per boring location. Discrete sampling depths ranged between 95 and 110 feet bgs. Groundwater samples were collected in four 40-mL VOA vials pre-preserved with HCL, then shipped to Datchem for VOC and 1,4-dioxane analysis (CLP Method SOM01.1 with SIM).

2.8 Residential Area Investigation

The residential area investigation included the installation and sampling of four nested soil gas probes in the Whispering Fountains Apartment Community, located at 12251 Washington Boulevard, Whittier, California. The purpose of this investigation was to determine existing VOC concentrations in soil gas and evaluate the potential for soil gas vapor intrusion into indoor air (including potential human health risks). The residential area was of potential concern due to the relatively shallow depth of groundwater (approximately 35 feet bgs) and elevated concentrations of VOCs in groundwater beneath this area. Soil sampling (for geotechnical analysis) and HydroPunch® sampling was conducted to provide data for the vapor transport modeling and human health and ecological risk assessment. CPTs also were conducted to assist with the selection of soil gas probe screen intervals, and discrete groundwater and soil sample depths.

Four boring locations (RA-1, RA-2, RA-3, and RA-4) were positioned at each corner of the apartment community boundaries for this investigation (Figure 2-10). CPT, HydroPunch®, soil, and soil gas borings were installed at these locations. These four locations were approved by EPA and were considered to be a representative data set for this area. A fifth location was originally proposed in the center of the apartments; however, site access restraints limited sampling activities to the apartment streets.

Gregg Drilling and Testing was selected as the subcontractor to perform all drilling and sampling activities at this site.

2.8.1 Cone Penetrometer Test Activities

CPTs were conducted during the advancement of four direct-push borings on January 9 and 10, 2007. A 25-ton truck-mounted CPT/direct-push rig was used to advance the borings. CPT borings were advanced to 46 feet bgs at RA-3 and 60 feet bgs at borings RA-2, RA-3, and RA-4.

The CPT procedure consists of pushing a cone-tipped cylindrical probe into the ground while simultaneously measuring the resistance to penetration. The CPT rig is a type of direct-push technology rig that is similar to Geoprobe™. The rig uses the weight of the truck in addition to the force of its hydraulic mechanism to drive the probe and/or sampling equipment to the target depth. The CPT probe contains two strain-gauge load cells that measure the soil-bearing resistance acting on the conical tip of the probe and the frictional resistance sensed along a friction sleeve. The cone is typically advanced at a rate of 2 centimeters per second (cm/sec) with the driving force provided by hydraulic rams in the CPT rig.

The CPT log was used to obtain a stratigraphic interpretation of the subsurface to determine screen depths for the soil gas probes, discrete groundwater samples, and soil sample intervals. The stratigraphic interpretation is based on relationships between tip resistance (qc), sleeve friction (fs), and penetration porewater pressure (U). The friction ratio (Rf) is a calculated parameter that is used to infer soil behavior type. Generally, cohesive soils (clays) have higher friction ratios, lower tip resistance, and generate large excess porewater pressures. Cohesionless soils (sands) have lower friction ratios, higher tip resistance, and generate little excess porewater pressure. The interpretation of soils follows correlations by Robertson and Campanella (1990).

Electronic copies of each CPT log are included in Appendix A.6.

2.8.2 HydroPunch® Sampling

Four soil borings (HPRA-1 to HPRA-4) were advanced with the CPT rig on January 9 and 10, 2007, for the purposes of discrete (HydroPunch®) groundwater sampling. Discrete samples were generally collected immediately below depth to water (35 feet bgs), and 10 feet below depth to water. The sample identification of discrete samples includes "HP" and the boring location (e.g., HPRA-1) followed by an "A" for the shallow depth (e.g., HPRA-1A) or "B" for the deeper depth (e.g., HPRA-1B).

Discrete groundwater samples were collected from each boring after a review of the CPT logs. The selected sampling intervals were predominantly coarse-grained sands. Discrete samples were collected at 43 and 53 feet bgs at HPRA-1 and HPRA-2, 50 and 60 feet bgs at HPRA-3, and 47 and 57 feet bgs at HPRA-4. A stainless-steel bailer was used to transfer groundwater from inside the direct-push rods to four 40-mL VOAs pre-preserved with HCL. Samples were immediately placed in coolers containing ice, then shipped to Datachem for VOC and 1,4-dioxane analysis (CLP Method SOM01.1 with SIM).

2.8.3 Soil Sampling

Discrete soil samples were collected from four soil borings (SSRA-1 to SSRA-4) on January 11 and 12, 2007. The borings were advanced with a truck-mounted HSA rig equipped with 6-inch-OD HSA flights. A California-modified ring sampler (split-barrel device) was used for the collection of 2-inch-diameter soil samples. The California-modified ring sampler allowed for undisturbed or in situ soil cores to be collected. The split-barrel sampling device is constructed of high-strength alloy steel with a tongue and groove arrangement running the length of the tube, allowing it to be split in half. The two halves are held together by a threaded-drive head assembly at the top, and a hardened shoe at the

bottom with a beveled cutting tip. The sampler, approximately 24 inches in length, is driven by a 140-pound weight dropped through a 30-inch interval. When the sampling barrel was brought to the surface, it was disassembled and the 2-inch-diameter brass rings (containing the soil cores) were removed. Undisturbed (in situ) soil samples were collected from soil borings, located immediately adjacent to the CPT, HydroPunch®, and soil gas borings. The purpose of the soil samples is to provide physical (geotechnical) data as input for soil vapor transport modeling in support of the HHRA.

Three discrete soil samples were collected from each of the four soil borings. Soil sample intervals were selected based on the review of the CPT logs. The sample identification of discrete samples includes “SS” and the boring location (e.g., SSRA-1) followed by an “A” for the shallow sample (e.g., SSRA-1A), “B” for the middle sample (e.g., SGRA-1B), and “C” for the deepest sample (e.g., SGRA-1C). The general approach was to collect samples from intervals with coarser-grained sands. Provided below is a summary of sample intervals that were submitted for laboratory analysis:

- SSRA-1: 11.5 to 12 feet bgs, 18.5 to 19 feet bgs, 28.5 to 29 feet bgs
- SSRA-2: 7 to 7.5 feet bgs, 12.5 to 13 feet bgs, 28.5 to 29 feet bgs
- SSRA-3: 12 to 12.5 feet bgs, 18.5 to 19 feet bgs, 28.5 to 29 feet bgs
- SSRA-4: 11 to 11.5 feet bgs, 18 to 18.5 feet bgs, 32 to 32.5 feet bgs

The 2-inch-diameter soil cores were capped with Teflon® sheets and plastic end caps, secured in a cooler, then transported by CH2M HILL staff to PTS Laboratories of Santa Fe Springs, California, for geotechnical analysis.

The analysis included the following parameters:

- Air filled porosity (calculated and reported by laboratory)
- Atterberg limits (American Society for Testing and Materials [ASTM] D4318)
- Bulk density (ASTM D2937)
- Grain density (ASTM D422)
- Grain size (API RP40)
- Moisture content (ASTM D2216)
- Total porosity (calculated and reported by laboratory)
- USCS soil type

Copies of the geotechnical reports are provided in Appendix D.

2.8.4 Soil Gas Probe Installation and Sampling

On January 11, 2007, four triple-nested soil gas probes (SGRA-1 to SGRA-4) were installed at each corner of the Whispering Fountains Apartments, immediately adjacent to the CPT and HydroPunch® soil borings. Probes were installed using a 25-ton truck-mounted CPT rig. Direct-push methods were used to advance a nominal 2-inch-diameter boring at each location. The sample identification of soil gas probes includes “SG” and the boring location (e.g., SGRA-1) followed by an “A” for the shallow screen (e.g., SGRA-1A), “B” for the middle screen (e.g., SGRA-1B), and “C” for the deepest screen (e.g., SGRA-1C). Course-grained lithologic units at least 3 feet above the water table were targeted as screen intervals.

Three individual soil gas probes were installed in each 2-inch-diameter borings. The probes consisted of three 6-inch-long, stainless-steel mesh screen implants attached to three 0.25-inch inside diameter (ID) Teflon® tubing with three labeled gas-tight valves at ground surface. The screen implants were surrounded by approximately 1.5 feet of filter pack consisting of No. 3 Monterey sand. A 0.5-foot, fine-grained sand interval (No. 60 transition sand) was placed over the top of the filter pack; 1 foot of dry granular bentonite was placed on top of the transition sand. Hydrated granular bentonite was then placed on top of the dry granular bentonite to within 1 to 1.5 feet of the bottom of each successive soil gas probe. A summary of soil gas probe completion details is presented in Table 2-10.

Soil gas samples were collected from the soil gas probes on January 15, 2007, after approximately 4 days of equilibration time. Figure 2-11 presents a schematic diagram of the purge and sample train used for sampling with an electric pump. The soil gas purge train consisted of a water and dust trap, vacuum gauge connected by copper tubing, calibrated flowmeter, and electric (oil-free) vacuum pump. The sample train consisted of a flow regulator, compression or Swagelok® fittings, and 400-mL SUMMA canister provided by the EPA Region 9 Laboratory. All SUMMA canisters were verified for full vacuum pressure (approximately 29 inches of mercury) prior to sampling.

To ensure that stagnant or ambient air was removed from the sampling system and to ensure that samples collected were representative of subsurface conditions, approximately three system volumes (300 mL) were purged prior to collecting samples. The vacuum purge rate was maintained at 100 milliliters per minute (mL/min). A stainless-steel, three-way switching valve was used to divert soil gas flow to the SUMMA canister after purging was complete. After purging, the vacuum pump was shut off; then the three-way switch valve was turned to allow flow to be diverted to the SUMMA canister. After approximately 5 minutes, the switch valve was closed and the SUMMA canister was detached from the sample train. Vacuum pressure was then measured in each canister to verify sample collection. All but three canisters were confirmed to have zero inches of mercury pressure. After sample collection, the brass plug caps were placed and tightened over the swage fittings. Samples were shipped immediately shipped to the EPA Region 9 Laboratory for VOCs analysis (EPA Method TO-15).

A leak test was conducted at each nested soil gas probe location during soil gas sampling. The leak check was performed at locations where ambient air could have entered the sampling system, typically near the base of the sampling probes at ground surface. Commercial-grade Bernzomatic® butane was used as the leak test compound. Butane was selected because it has not been measured in soil gas samples collected at the Omega property. Prior to purging each probe, butane was released near the base of the probe at ground surface. A 4-inch-diameter plastic cap was placed over the butane discharge point and the base of the soil gas probes to maintain a “cloud” of butane for the duration of sampling.

2.9 Field Quality Assurance/Quality Control Procedures

QC samples were collected or prepared to assist in determining data reliability. QC samples collected in this investigation include field duplicates, ambient blanks, equipment blanks,

trip blanks, and laboratory QC samples (matrix spike/matrix spike duplicate [MS/MSD]). A description of each sample is provided below.

2.9.1 Field Duplicates

The field duplicate is an independent sample collected as close as possible to the original sample from the same source and is used to document sampling precision. The duplicate samples were labeled and packaged in the same manner as other samples so that the laboratory could not distinguish between samples and duplicates. An attempt was made to take the duplicate sample from a location that is expected or known to be moderately contaminated. Each duplicate was taken using the same sampling and preservation method as other samples. Field duplicates were collected at a minimum frequency of 1 in every 10 samples. For soil gas sampling, a T-connector fitting was used to fill primary and field duplicate samples simultaneously.

2.9.2 Ambient Blanks

Ambient blanks were collected to verify that contamination was not introduced to samples during collection, handling, or shipping of the samples. They were prepared by pouring blank water directly into the sample bottles. Analyte-free water was used for organic analyses using the same preservation methods and packaging and sealing procedures used during collection of groundwater samples. Ambient blanks were prepared and labeled in the same manner as the field samples and sent “blind” to the laboratory. Ambient blanks were collected at a minimum frequency of 1 in every 10 samples.

2.9.3 Equipment Blanks

Equipment blanks were collected to verify that contamination was not introduced to samples through the use of decontaminated equipment. Equipment blanks were prepared by pouring deionized water over the sampling device and into pre-preserved VOAs for VOC analysis. Equipment blanks were prepared following decontamination for each piece of reusable sampling equipment. No equipment blanks were collected during soil gas sampling.

2.9.4 Trip Blanks

The purpose of trip blanks is to verify that volatile contamination is not introduced to samples during transportation or through transportation materials. For groundwater sampling, trip blanks were prepared by the laboratory and were analyzed for VOCs only. The trip blanks were carried in a sample cooler throughout the day and returned to the laboratory with the field samples. In accordance with direction from EPA, no trip blanks were to be submitted to EPA’s Region 9 Laboratory if an equipment blank or ambient blank was collected for a particular day of sampling.

For soil gas sampling, empty SUMMA canisters provided by the EPA Region 9 Laboratory were shipped to the laboratory, then filled with ultra-pure nitrogen and analyzed as a normal sample (this constitutes a trip/equipment blank sample). The SUMMA canisters were not opened in the field and remained under vacuum until they arrived at the laboratory. Trip blanks were collected at a minimum frequency of 1 in every 10 samples.

2.9.5 Laboratory QC Samples

Laboratory QC samples (i.e., MS/MSDs) were collected during routine groundwater sampling and HydroPunch® sampling. One MS/MSD sample was designated for every 20 field samples or for each 14-day sampling period, whichever is the more frequent. A double volume of sample was collected when MS/MSD samples were required. The first sample volume is for the target sample; the second volume is for the MS and MSD analysis. Collection of MS/MSDs was coordinated with the laboratory. The sample was identified and denoted as “Lab QC” on the sample container and the chain-of-custody record.

2.10 Investigation-Derived Waste

IDW generated during the implementation of this field investigation included solids and liquids. Solids include soil cuttings and drilling mud (bentonite and water) from drilling and soil sampling activities. Liquid waste includes decontaminant rinsate water, well development water, groundwater sampling purge water, and aquifer testing purge water. Analytical profiling samples were collected for both matrixes and submitted to the EPA Region 9 Laboratory for analysis.

Solids were analyzed for VOCs (EPA Method 8260B), California Assessment Manual (CAM) 17 metals (EPA Method 6010B), pH (EPA Method 9040B/9045C), total petroleum hydrocarbons as gasoline (TPH-g) (EPA Method 8015B), and total petroleum hydrocarbons as diesel (TPH-d) (EPA Method 8015B). Grab samples were collected using a clean stainless-steel trowel or shovel. Sample containers for VOCs and TPH-g included six 40-mL glass VOA vials, pre-weighed with stir bars. Six 5-gram encore containers were used in lieu of VOA vials if the soil was competent enough for soil sample extraction using an encore sampling device. A 12-ounce glass jar was used as a container for the remaining solids analysis.

Water samples were analyzed for VOCs (EPA Method 524.2), CAM 17 total metals (EPA Method 200.7/245.1), pH (EPA Method 150.1), 1,4-dioxane (EPA Method 8270C), hexavalent chromium (EPA Method 218.6), TPH-g (EPA Method 8015B), and TPH-d (EPA Method 8015B). Grab samples were collected using a disposable polyethylene bailer connected to a clean polyethylene rope. Samples collected for VOCs were placed in three 40-mL glass VOA vials pre-preserved with HCL. Samples collected for metals were placed in a 1-liter polyethylene bottle pre-preserved with nitric acid. Samples collected for 1,4-dioxane were placed in two 1-liter glass amber bottles. Samples collected for hexavalent chromium and pH were placed in one 250-mL polyethylene bottle.

Transportation waste manifests are presented in Appendix E.

2.10.1 Monitoring Well Construction – Nested Wells

Waste generated from the construction of nested wells MW24, MW25, MW26, and MW27 included soil cuttings, drilling mud, and well development water. In general, the drill cuttings and drilling mud were segregated from well development water at each well location and stored in plastic-lined, 20-cubic-yard (yd³), roll-off bins. Up to six roll-off bins were stored at each well location.

Haz Mat Trans of San Bernardino, California, was retained as the subcontractor to WDC for the storage and removal of waste. Both solid and liquid waste was transported under nonhazardous manifest to the Chemical Waste Management facility in Kettleman City, California.

2.10.2 Monitoring Well Construction – Single-Screen Wells

Waste generated from the construction of single-screen wells MW23A, MW28, MW29, and MW30 included soil cuttings and well development water. The drill cuttings were stored in one 20- yd³ roll-off bin, and the well development water was stored in a 5,000-gallon Baker tank. The roll-off bin and Baker tank were staged in the northeast corner of the Little Lake Park parking lot, located off Lakeland Boulevard in Santa Fe Springs, California.

Clear Blue Environmental of Los Alamitos, California, was retained as the subcontractor to Boart Longyear for the storage and removal of waste. Solid waste was transported under nonhazardous manifest to the Chemical Waste Management facility in Kettleman City, California. Liquid waste was transported under nonhazardous manifest to the Siemens Water Technologies facility in Vernon, California.

2.10.3 HydroPunch® and Soil Sampling

Waste generated from the HydroPunch® and residential area investigations included both liquid and solid waste. The decontamination of direct-push equipment used for the HydroPunch® sampling generated liquid wastes. Solid waste included soil cuttings generated from the HSA drilling and soil sampling. Both liquid and solid waste was stored in Department of Transportation (DOT)-approved 55-gallon drums, which were staged at the city of Whittier storage lot located at 1201 Hadley Street, Whittier, California.

American Integrated Services (AIS) of Long Beach, California, was retained as a subcontractor to Gregg Drilling for the storage and transportation of waste. Solid waste was transported under nonhazardous manifest to the Crosby and Overton facility in Long Beach, California. Liquid waste was transported under nonhazardous and RCRA-hazardous manifest to the Crosby and Overton facility.

2.10.4 Routine Groundwater Sampling

Groundwater sampling purge water was generated during the routine collection of groundwater samples from EPA and OPOG monitoring wells. DOT-approved 55-gallon drums were used to containerize the waste. The drums were staged behind the Three Kings Construction parking lot, located at 12512 Whittier Boulevard.

Asbury Environmental Services of Compton, California, and Clear Blue Environmental were retained by CH2M HILL for the storage and removal of waste. Liquid waste was transported under nonhazardous and non-RCRA hazardous manifest to the Demenno/Kerdoon facility in Compton, California.

2.10.5 Aquifer Testing

Liquid waste generated during aquifer testing included decontaminant rinsate water and purge water. A small quantity of decontaminant rinsate water was generated during slug testing activities. This water was stored in DOT-approved 55-gallon drums and staged

behind the Three Kings Construction parking lot. Clear Blue Environmental was retained by CH2M HILL for the profiling and transport of the liquid waste. The waste was transported under nonhazardous manifest to the U.S. Filter Recovery Service of Vernon, California.

Purge water was generated during aquifer testing of wells EW1, MW23A, MW24, MW26, MW27, and MW30. Purge water was stored in 13,000-gallon or 21,000-gallon Baker tanks located immediately adjacent to each well. After profiling, the water was pumped directly from each Baker tank into 5,000-gallon capacity vacuum trucks for transport. Approximately 19,300 gallons of water was generated during testing of EW1. This waste was transported by Enviroserve of Signal Hill, California, under nonhazardous waste manifest to the Lakeland Processing facility in Santa Fe Springs, California. Approximately 40,000 gallons of purge water was generated during testing of wells MW23A, MW24, MW26, MW27, and MW30. This water also was transported by Enviroserve under nonhazardous manifest to the Crosby and Overton facility.

2.11 Community Involvement

Community involvement for this investigation was limited to communication with state of California and city (Whittier, Santa Fe Springs, and Norwalk) employees and legal representatives. In cases where private access agreements were executed, communication was limited to private property owners, tenants, employees, and legal representatives.

The contacted parties were informed about the purpose and scope of the investigation. No public flyers were distributed during the investigation.

Table 2-1
Omega Well Construction Details
Omega Chemical Superfund Site

Well ID	X Coordinate (meters)	Y Coordinate (meters)	Surface Elevation (feet amsl)	TOC Elevation (feet amsl)	Depth to Screen Top (feet bgs)	Depth to Screen Bottom (feet bgs)	Total Depth (feet bgs)	Total Depth Drilled (feet bgs)	Borehole Diameter (inches)	Casing Diameter (inches)	Screen Material	Screen Slot Size (inches)	Casing Material	Filter Pack Grade	Filter Pack Top (feet bgs)	Filter Pack Bottom (feet bgs)	Drilling Method	Annular Seal Material	Annular Seal Top (feet bgs)	Annular Seal Bottom (feet bgs)
OW1A	403554.4000	3759242.1000	209.99	212.50	63	77.5	77.5	80	10	4	SST	0.02	SCH40 PVC	2/12	59	78	hollow stem auger	neat slurry	3.5	56.2
OW1B	403542.8490	3759236.7550	207.37	207.18	110	120	120	130	10	4	SST	0.02	Mild Steel	2/12	99	130	hollow stem auger	95/5 slurry bentonite pellets	0 96	96 99
OW2	403461.2000	3759246.6000	203.24	202.30	60	80	80	85	10	4	SST	0.02	Mild Steel	2/12	55	85	hollow stem auger	95/5 slurry bentonite pellets	0 50	50 55
OW3A	403503.4000	3759170.1000	199.08	198.53	63	83	83	85	10	4	SST	0.02	Mild Steel	2/12	58	85	hollow stem auger	95/5 slurry bentonite pellets	0 53	53 58
OW3B*	403522.0000	3759148.0000	194.86	197.06	112	122	122	139	10	4	SST	0.01	SCH40 PVC	2/12	106	126	mud rotary	95/5 slurry bentonite chips #30 transition sand	0 99 105	99 105 107
OW4A	403320.6000	3759071.9000	184.93	184.67	49.8	69.8	69.8	80	10	4	SST	0.02	Mild Steel	2/12	47.7	75.7	hollow stem auger	95/5 slurry bentonite pellets	2 42.5	42.5 47.7
OW4B	403317.0360	3759072.3480	184.95	184.50	112	122.3	122.3	132	10	4	SST	0.02	Mild Steel	2/12	109.5	132	hollow stem auger	95/5 slurry bentonite pellets	2 105	105 109.5
OW5	402744.6000	3758929.8000	154.88	154.16	30	50	50	52	10	4	SST	0.02	SCH40 PVC	2/12	25	51	hollow stem auger	95/5 slurry bentonite	0 20	20 25
OW6	403207.7000	3758942.3000	173.14	172.74	38	58	58	61.5	10	4	SST	0.02	Mild Steel	2/12	36	59	hollow stem auger	95/5 slurry bentonite chips	2 30.5	30.5 36
OW7	403600.4000	3759301.6000	215.54	214.21	70.9	90.9	90.9	92	10	4	SST	0.02	Mild Steel	2/12	65	92.5	hollow stem auger	95/5 slurry bentonite pellets	2 60.6	60.6 65
OW8A	403481.6370	3759209.4910	201.20	200.64	60.4	80	80	81	10	4	SST	0.02	Mild Steel	2/12	55	81	hollow stem auger	95/5 slurry bentonite pellets	2 51	51 55
OW8B	403480.0430	3759212.7890	201.43	200.82	116	126	126	143	10	4	SST	0.01	SCH40 PVC	2/12	111.3	128	mud rotary	95/5 slurry	2	110
MW1A	402749.8678	3759022.8370	157.81	157.71	45	60	60	60	10	4	SCH40 PVC	0.02	SCH40 PVC	3	41.5	60	hollow stem auger	95/5 slurry medium chips	1 35	35 42
MW1B	402749.9621	3759020.3187	158.10	158.05	75	85.4	85.4	95	10	4	SCH40 PVC	0.02	SCH40 PVC	3	72	86	hollow stem auger	95/5 slurry bentonite pellets	1 67	67 72
MW2	402799.4810	3758870.1561	154.24	154.21	45	60	60	60	10	4	SCH40 PVC	0.02	SCH40 PVC	3	42.5	60	hollow stem auger	95/5 slurry bentonite pellets	1 38	38 42
MW3	402931.5361	3758376.4901	151.86	151.48	38	48	48	51.3	10	4	SCH40 PVC	0.02	SCH40 PVC	3	35.5	48	hollow stem auger	95/5 slurry bentonite chips	1 32	32 36
MW4A	402537.1475	3758403.1393	147.02	146.80	42.7	53	53	53	10	4	SCH40 PVC	0.02	SCH40 PVC	3	38.5	53	hollow stem auger	95/5 slurry bentonite chips	1 36	36 38.5
MW4B	402539.6698	3758404.8988	147.00	146.84	69.7	80	80	125	10	2	SCH40 PVC	0.02	SCH40 PVC	3	67	80	mud rotary	95/5 slurry bentonite chips/pellets	1 61.5	61.5 67
MW4C	402539.8674	3758404.7150	147.39	147.10	88.7	99	99	125	10	2	SCH40 PVC	0.02	SCH40 PVC	3	85	99.5	mud rotary	bentonite pellets	80	85
MW5	402519.7145	3758707.9616	150.84	150.60	43.3	53.3	53.3	53	10	4	SCH40 PVC	10.00	SCH40 PVC	3	40.5	53.3	hollow stem auger	95/5 slurry bentonite chips	1 34	34 40.5
MW6	402213.7998	3758823.5521	150.39	150.28	37.1	47.5	47.5	47.5	10	4	SCH40 PVC	0.02	SCH40 PVC	3	35	47.5	hollow stem auger	95/5 slurry bentonite pellets	1 32	32 35
MW7	402772.1185	3757891.0470	143.59	143.28	35.8	46	46	46	10	4	SCH40 PVC	0.02	SCH40 PVC	3	31	46	hollow stem auger	95/5 slurry bentonite chips	1 28	28 31
MW8A	402025.0430	3758460.7972	150.44	150.14	30	45	45	45	10	4	SCH40 PVC	0.02	SCH40 PVC	3	27	45	hollow stem auger	95/5 slurry bentonite chips	1 22	22 27

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MW8B	402028.6156	3758457.7772	150.33	150.03	65	75	75	93	10	2	SCH40 PVC	0.02	SCH40 PVC	3	63	75	hollow stem auger	95/5 slurry bentonite pellets	1 59	59 63
MW8C	402028.4773	3758457.8119	150.33	150.03	86.7	91.7	91.7	93	10	2	SCH40 PVC	0.02	SCH40 PVC	3	84	93	hollow stem auger	bentonite pellets	75	83.5
MW8D	402021.5454	3758462.1309	150.09	149.91	110	120	120	150	10	4	SCH40 PVC	0.02	SCH40 PVC	3	108	122.5	mud rotary	95/5 slurry bentonite pellets	1 103	103 108
MW9A	401709.5798	3758510.4304	148.88	148.84	25	35	35	90	10	4	SCH40 PVC	0.02	SCH40 PVC	3	23	35	hollow stem auger	95/5 slurry bentonite chips	1 18	18 23
MW9B	401711.8963	3758510.1513	149.06	148.90	49.8	60	60	65	10	4	SCH40 PVC	0.02	SCH40 PVC	3	47	65	hollow stem auger	95/5 slurry bentonite pellets	1 44	44 47
MW10	402019.5356	3757645.7219	147.40	147.45	52	62	62	65	10	4	SCH40 PVC	0.02	SCH40 PVC	3	49	65	hollow stem auger	95/5 slurry bentonite pellets	1 45	45 49
MW11	402265.9120	3757445.4058	150.94	150.89	40	50	50	55	10	4	SCH40 PVC	0.02	SCH40 PVC	3	38	55	hollow stem auger	95/5 slurry bentonite chips	1 31	31 37
MW12	403349.1800	3759544.0500	220.53	220.87	82	97	102.18	102	6	2	SCH80 PVC	0.01	SCH80 PVC	30	80	102	sonic	95/5 slurry	1	80
MW13A	403429.2800	3759304.2900	206.33	206.02	56	66	72.2	71	10	2	SCH80 PVC	0.02	SCH80 PVC	2/16	54	69	mud rotary	95/5 slurry medium chips	1 52	52 54
MW13B	403429.2800	3759304.2900	206.33	205.88	123	133	138.4	138	10	2	SCH80 PVC	0.02	SCH80 PVC	2/16	121	139	mud rotary	medium chips 1:1 medium chips	69 71 119	71 119 121
MW14	403113.1900	3759053.8700	172.97	172.63	60	75	79.91	80	6	2	SCH80 PVC	0.02	SCH80 PVC	2/12	57	80	sonic	95/5 slurry medium chips	1 55	55 57
MW15	402532.6800	3758539.7300	148.65	148.28	50	70	74.95	75	6	2	SCH80 PVC	0.01	SCH80 PVC	2/12	48	75	sonic	95/5 slurry medium chips	1 46	46 48
MW16A	401492.7800	3757951.1300	153.47	153.19	45	60	65.93	65	8.75	2	SCH80 PVC	0.02	SCH80 PVC	2/16	43	60	mud rotary	95/5 slurry medium chips	1 40	40 43
MW16B	401492.7800	3757951.1300	153.47	153.19	106	116	120.19	121	8.75	2	SCH80 PVC	0.02	SCH80 PVC	2/16	104	118	mud rotary	1:1 medium chips	65 102	102 104
MW16C	401492.7800	3757951.1300	153.47	153.26	149	164	169.7	169	8.75	2	SCH80 PVC	0.02	SCH80 PVC	3	147	169	mud rotary	medium chips 1:1 medium chips	118 121 145	121 145 147
MW17A	401264.1800	3757463.4200	159.40	159.03	56	71	75.67	76	8.75	2	SCH80 PVC	0.02	SCH80 PVC	2/16	54	73	mud rotary	95/5 slurry medium chips	1 52	52 54
MW17B	401264.1800	3757463.4200	159.40	158.90	94	104	109.7	109	8.75	2	SCH80 PVC	0.02	SCH80 PVC	2/16	92	107	mud rotary	medium chips 1:1 medium chips	73 76 90	76 90 92
MW17C	401264.1800	3757463.4200	159.40	159.00	172	182	187.15	187	8.75	2	SCH80 PVC	0.02	SCH80 PVC	2/16	170	190	mud rotary	medium chips 1:1 medium chips	107 109 168	109 168 170
MW18A	402590.5500	3757631.0500	144.32	143.73	56	71	75.95	76	8.75	2	SCH80 PVC	0.02	SCH80 PVC	2/16	54	76	mud rotary	95/5 slurry medium chips	1 52	52 54
MW18B	402590.5500	3757631.0500	144.32	143.83	90	100	105.47	105	8.75	2	SCH80 PVC	0.02	SCH80 PVC	2/16	88	103	mud rotary	1:1 medium chips	76 86	86 88
MW18C	402590.5500	3757631.0500	144.32	143.83	146	161	166.6	166	8.75	2	SCH80 PVC	0.02	SCH80 PVC	2/16	144	164	mud rotary	medium chips 1:1 medium chips	103 105 142	105 142 144
MW19	401687.0600	3756760.8500	159.01	158.73	56	71	74.8	76	6	2	SCH80 PVC	0.02	SCH80 PVC	2/16	54	76	sonic	95/5 slurry medium chips	1 52	51 54
MW20A	400670.8400	3756601.7200	142.07	141.31	75	90	94.7	95	10	2	SCH80 PVC	0.02	SCH80 PVC	2/12	73	87	mud rotary	95/5 slurry medium chips	1 70	70 73

Table 2-1
Omega Well Construction Details
Omega Chemical Superfund Site

Well ID	X Coordinate (meters)	Y Coordinate (meters)	Surface Elevation (feet amsl)	TOC Elevation (feet amsl)	Depth to Screen Top (feet bgs)	Depth to Screen Bottom (feet bgs)	Total Depth (feet bgs)	Total Depth Drilled (feet bgs)	Borehole Diameter (inches)	Casing Diameter (inches)	Screen Material	Screen Slot Size (inches)	Casing Material	Filter Pack Grade	Filter Pack Top (feet bgs)	Filter Pack Bottom (feet bgs)	Drilling Method	Annular Seal Material	Annular Seal Top (feet bgs)	Annular Seal Bottom (feet bgs)
MW20B	400670.8400	3756601.7200	142.07	141.32	122	132	137.7	137	10	2	SCH80 PVC	0.02	SCH80 PVC	2/12	120	137	mud rotary	medium chips 1:1 medium chips	87 89 118	89 118 120
MW20C	400670.8400	3756601.7200	142.07	141.35	180	190	195.2	195	10	2	SCH80 PVC	0.02	SCH80 PVC	2/12	178	196	mud rotary	medium chips 1:1 medium chips	132 134 176	134 176 178
MW21	400223.2600	3756893.9900	129.27	128.81	64	79	84.8	84	6	2	SCH80 PVC	0.02	SCH80 PVC	2/16	61	83	sonic	95/5 slurry medium chips	1 59	59 61
MW22	400466.1900	3757381.9000	151.47	150.82	74	89	93.83	94	6	2	SCH80 PVC	0.02	SCH80 PVC	2/16	71	94	sonic	95/5 slurry medium chips	1 68	68 71
MW23A	402207.2296	3758346.3553	149.07	148.76	35	55	60.00	62	8	4	SCH80 PVC	0.02	SCH80 PVC	3	32	62	sonic	95/5 slurry medium chips	1 26	26 32
MW23B	402203.7800	3758349.1800	149.36	149.06	82	97	101.6	102	10	2	SCH80 PVC	0.02	SCH80 PVC	2/16	86	99	mud rotary	95/5 slurry transitional sand	1 85	85 86
MW23C	402203.7800	3758349.1800	149.36	149.07	145	160	164.55	165	10	2	SCH80 PVC	0.02	SCH80 PVC	2/16	143	162	mud rotary	medium chips 1:1 transitional sand	99 102 142	102 142 143
MW23D	402203.7800	3758349.1800	149.36	148.04	175	185	189.8	190	10	2	SCH80 PVC	0.02	SCH80 PVC	2/16	173	190	mud rotary	medium chips 1:1 transitional sand	161 164 171	164 171 173
MW24A	402993.5009	3758908.7331	162.44	162.04	50	70	75	200	16	4	SCH80 PVC	0.02	SCH80 PVC	3	47	75	mud rotary	95/5 slurry medium chips	1 40	40 47
MW24B	402993.3534	3758908.7679	162.44	162.03	110	125	130	200	16	2	SCH80 PVC	0.02	SCH80 PVC	3	107	130	mud rotary	1:1 medium chips	75 100	100 107
MW24C	402993.4479	3758908.9665	162.44	162.02	140	160	165	200	16	4	SCH80 PVC	0.02	SCH80 PVC	3	137	163	mud rotary	medium chips	130	137
MW24D	402993.5391	3758908.8547	162.44	162.05	173	178	183	200	16	2	SCH80 PVC	0.02	SCH80 PVC	3	170	185	mud rotary	medium chips	163	170
MW25A	401814.5784	3757890.5951	148.25	147.90	45	65	70	220	14.5	4	SCH80 PVC	0.02	SCH80 PVC	3	41	71	mud rotary	95/5 slurry medium chips	1 35	35 41
MW25B	401814.5418	3757890.6288	148.25	147.84	90	110	115	220	14.5	2	SCH80 PVC	0.02	SCH80 PVC	3	85	116	mud rotary	1:1 medium chips	71 80	80 85
MW25C	401814.5418	3757890.6288	148.25	147.86	140	150	155	220	14.5	4	SCH80 PVC	0.02	SCH80 PVC	3	135	156	mud rotary	1:1 medium chips	116 130	130 135
MW25D	401814.5418	3757890.6288	148.25	147.87	194	209	214	220	14.5	2	SCH80 PVC	0.02	SCH80 PVC	3	189	220	mud rotary	1:1 medium chips	156 184	184 189
MW26A	401270.0608	3757125.1557	155.98	155.62	70	90	95	250	14.5	4	SCH80 PVC	0.02	SCH80 PVC	3	65	93	mud rotary	95/5 slurry medium chips	1 57	57 65
MW26B	401269.9123	3757125.0907	155.98	155.45	105	120	125	250	14.5	2	SCH80 PVC	0.02	SCH80 PVC	3	100	126.5	mud rotary	medium chips	93	100
MW26C	401270.0435	3757125.2668	155.98	155.41	145	160	165	250	14.5	2	SCH80 PVC	0.02	SCH80 PVC	3	140	166	mud rotary	1:1 medium chips	126.5 135	135 140
MW26D	401269.9045	3757125.2349	155.98	155.37	185	205	210	250	14.5	2	SCH80 PVC	0.02	SCH80 PVC	3	180	212	mud rotary	1:1 medium chips	166 175	175 180
MW27A	400902.9714	3755901.7834	139.47	139.24	90	110	115	225	14.5	4	SCH80 PVC	0.02	SCH80 PVC	2/12	87	115	mud rotary	95/5 slurry medium chips	1 78	78 87
MW27B	400903.0537	3755901.6938	139.47	139.18	144	164	169	225	14.5	4	SCH80 PVC	0.02	SCH80 PVC	2/12	141	168	mud rotary	1:1 medium chips	115 130	130 141
MW27C	400902.8870	3755901.6623	139.47	139.17	180	190	195	225	14.5	2	SCH80 PVC	0.02	SCH80 PVC	2/12	177	193	mud rotary	medium chips	168	177

Table 2-1
Omega Well Construction Details
Omega Chemical Superfund Site

Well ID	X Coordinate (meters)	Y Coordinate (meters)	Surface Elevation (feet amsl)	TOC Elevation (feet amsl)	Depth to Screen Top (feet bgs)	Depth to Screen Bottom (feet bgs)	Total Depth (feet bgs)	Total Depth Drilled (feet bgs)	Borehole Diameter (inches)	Casing Diameter (inches)	Screen Material	Screen Slot Size (inches)	Casing Material	Filter Pack Grade	Filter Pack Top (feet bgs)	Filter Pack Bottom (feet bgs)	Drilling Method	Annular Seal Material	Annular Seal Top (feet bgs)	Annular Seal Bottom (feet bgs)
MW27D	400902.9879	3755901.5947	139.47	139.13	200	210	215	225	14.5	2	SCH80 PVC	0.02	SCH80 PVC	2/12	197	225	mud rotary	medium chips	193	197
MW28	400066.1942	3755133.6448	120.40	119.91	85	105	110	112	8	4	SCH80 PVC	0.02	SCH80 PVC	3	80	112	sonic	95/5 slurry medium chips	1 74	74 80
MW29	400888.7643	3753618.8894	107.34	107.10	90	110	115	117	8	4	SCH80 PVC	0.02	SCH80 PVC	3	87	117	sonic	95/5 slurry medium chips	1 80	80 87
MW30	401820.1912	3753277.4081	107.24	106.70	95	115	120	130	8	4	SCH80 PVC	0.02	SCH80 PVC	3	91	120	sonic	95/5 slurry medium chips medium chips	1 85 120	85 91 130
EW1	402022.7900	3758460.3700	150.02	149.51	65	75	80	80	8.75	4	SCH80 PVC	0.02	SCH80 PVC	2/12	63	78	mud rotary	95/5 slurry medium chips	1 60	60 63

Notes:
* Survey information for OW3B is not currently available. Coordinates are approximate.
X and Y coordinates surveyed in UTM meters, NAD 83, Zone 11
Surface and TOC elevations surveyed in NGVD 88 datum, benchmark of DYHS (Downey High School)

Abbreviations:
amsl - above mean sea level
bgs - below ground surface
SCH - schedule
PVC - polyvinyl chloride
SST - stainless steel
TOC - top of casing

Table 2-2
OPOG Groundwater Monitoring Schedule
Omega Chemical Superfund Site

Well	2nd QTR 1996 Jun 6	3rd QTR 1999 Jul 2	2nd QTR 2001 May 15 to May 16	3rd QTR 2001 Aug 16 to Aug 17	4th QTR 2001 Nov 15 to Nov 16	1st QTR 2002 Feb 14 to Mar 27	3rd QTR 2002 Aug 20 to Aug 22	1st QTR 2003 Feb 19 to Mar 13	1st QTR 2003 Mar 10 to Mar 13	3rd QTR 2003 Aug 26 to Aug 28	4th QTR 2003 Nov 20	1st QTR 2004 Feb 24 to Feb 27	3rd QTR 2004 Aug 24 to Aug 27	1st QTR 2005 Feb 23 to Feb 25	3rd QTR 2005 Aug 22 to Aug 25	1st QTR 2006 Feb 17 to Feb 22	1st QTR 2006 Mar 13	3rd QTR 2006 Aug 22 to Aug 24	1st QTR 2007 Feb 20 to Feb 22	3rd QTR 2007 Aug 21 to Aug 23
OW1A	VOCs, Metals, Alk, Anions, TDS	VOCs, 1,2,3-TCP	VOCs, SVOCs, 1,2,3- TCP, Perchlorate, Metals, Pest	VOCs, SVOCs, 1,2,3- TCP, Perchlorate, Metals, Pest	VOCs, SVOCs, 1,4-D, 1,2,3-TCP, Perchlorate, Metals, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3-TCP, Cr ⁶ , Anions, Pest	-----	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, SVOCs, 1,4-D, 1,2,3-TCP, Perchlorate, NDMA, Metals, Alk, Anions, TDS	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP
OW1B	-----	VOCs, 1,2,3-TCP	VOCs, SVOCs, 1,2,3- TCP, Perchlorate, Metals, Pest	VOCs, SVOCs, 1,2,3- TCP, Perchlorate, Metals, Pest	VOCs, SVOCs, 1,4-D, 1,2,3-TCP, Perchlorate, Metals, Pest	VOCs, SVOCs, 1,4-D, 1,2,3-TCP, Perchlorate, Metals	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3-TCP, Cr ⁶ Perchlorate, Anions, Pest	-----	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP
OW2	-----	VOCs, 1,2,3-TCP	VOCs, 1,2,3-TCP	VOCs, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3-TCP, Cr ⁶ Perchlorate, Anions, Pest	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP
OW3A	-----	VOCs, 1,2,3-TCP	VOCs, 1,2,3-TCP	VOCs, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3-TCP, Cr ⁶ Perchlorate, Anions, Pest	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP
OW3B	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, 1,4-D, 1,2,3- TCP, Perchlorate, Metals, Anions, TDS	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP
OW4A	-----	-----	-----	VOCs, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3-TCP, Cr ⁶ Perchlorate, Anions, Pest	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP
OW4B	-----	-----	VOCs, 1,2,3-TCP	VOCs, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3-TCP, Cr ⁶ Perchlorate, Anions, Pest	-----	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP
OW5	-----	-----	-----	VOCs, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,2,3-TCP	VOCs, 1,2,3-TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP
OW6	-----	-----	VOCs, 1,2,3-TCP	VOCs, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,2,3-TCP	VOCs, 1,2,3-TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP
OW7	-----	-----	-----	-----	-----	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,2,3-TCP	VOCs, 1,2,3-TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP
OW8A	-----	-----	-----	-----	-----	VOCs, 1,4-D, 1,2,3-TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3-TCP, Cr ⁶ Perchlorate, Anions, Pest	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP		VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP, Metals, Alk, Anions	VOCs, 1,4-D, 1,2,3- TCP	VOCs, SVOCs, 1,4-D, 1,2,3-TCP, Perchlorate, NDMA, Metals, Alk, Anions, TDS	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP
OW8B	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP		VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP	VOCs, 1,4-D, 1,2,3- TCP

Notes:
1) ---- No sample was collected or well was not constructed at this time

Abbreviations:
VOCs = volatile organic compounds
SVOCs = semi-volatile organic compounds
1,4-D = 1,4-dioxane
Cr+6 = hexavalent chromium
NDMA = n-nitrosodimethylamine
1,2,3-TCP = 1,2,3-trichloropropane
CN = total cyanide
TDS = total dissolved solids
Alk = alkalinity
Pest = Pesticides

Table 2-3

Weston Solutions Groundwater Monitoring Schedule
Omega Chemical Superfund Site

Well	1st QTR 2002 Feb 13 to Feb 26	2nd QTR 2002 May 21 to May 31	3rd QTR 2002 Aug 20 to Aug 29	4th QTR 2002 Nov 13 to Nov 26	1st QTR 2003 Feb 18 to Feb 23	2nd QTR 2003 May 13 to May 22	3rd QTR 2003 Aug 19 to Aug 28
OPOG Monitoring Wells							
OW1A	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest, GChem	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, Perchlorate, Metals, CN, GChem	VOCs, 1,4-D, Perchlorate, Metals, CN	VOCs, 1,4-D, Perchlorate, Metals, CN
OW1B	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest, GChem	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, 1,4-D, Perchlorate, Metals, CN, GChem	VOCs, 1,4-D, Perchlorate, Metals, CN	VOCs, 1,4-D, Perchlorate, Metals, CN
OW2	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest, GChem	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, Perchlorate, Metals, CN, GChem	VOCs, Perchlorate, Metals, CN	VOCs, Perchlorate, Metals, CN
OW3A	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest, GChem	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, Perchlorate, Metals, CN, GChem	VOCs, Perchlorate, Metals, CN	VOCs, Perchlorate, Metals, CN
OW4A	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest, GChem	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, 1,4-D, Perchlorate, Metals, CN, GChem	VOCs, Perchlorate, Metals, CN	VOCs, 1,4-D, Perchlorate, Metals, CN
OW4B	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest, GChem	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, Perchlorate, Metals, CN, GChem	VOCs, Perchlorate, Metals, CN	VOCs, Perchlorate, Metals, CN
OW5	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest, GChem	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, 1,4-D, Perchlorate, Metals, CN, GChem	VOCs, 1,4-D, Perchlorate, Metals, CN	VOCs, 1,4-D, Perchlorate, Metals, CN
OW6	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest, GChem	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, 1,4-D, Perchlorate, Metals, CN, GChem	VOCs, 1,4-D, Perchlorate, Metals, CN	VOCs, 1,4-D, Perchlorate, Metals, CN
OW7	-----	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, Perchlorate, Metals, CN, GChem	VOCs, Perchlorate, Metals, CN	VOCs, Perchlorate, Metals, CN
OW8A	-----	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, 1,4-D, Perchlorate, Metals, CN, GChem	VOCs, 1,4-D, Perchlorate, Metals, CN	VOCs, 1,4-D, Perchlorate, Metals, CN
EPA Monitoring Wells							
MW1A	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest, GChem	VOCs, SVOCs, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, Perchlorate, Metals, CN, GChem	VOCs, Perchlorate, Metals, CN	VOCs, Perchlorate, Metals, CN
MW1B	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest, GChem	VOCs, SVOCs, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, Perchlorate, Metals, CN, GChem	VOCs, Perchlorate, Metals, CN	VOCs, Perchlorate, Metals, CN

Weston Solutions Groundwater Monitoring Schedule *Omega Chemical Superfund Site*

Table2-2to2-4_Sample Frequency.xls/Table2-3-Weston

Table 2-3

Weston Solutions Groundwater Monitoring Schedule
Omega Chemical Superfund Site

Well	1st QTR 2002 Feb 13 to Feb 26	2nd QTR 2002 May 21 to May 31	3rd QTR 2002 Aug 20 to Aug 29	4th QTR 2002 Nov 13 to Nov 26	1st QTR 2003 Feb 18 to Feb 23	2nd QTR 2003 May 13 to May 22	3rd QTR 2003 Aug 19 to Aug 28
MW10	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest, GChem	VOCs, SVOCs, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, 1,4-D, Perchlorate, Metals, CN, GChem	VOCs, 1,4-D, Perchlorate, Metals, CN	VOCs, 1,4-D, Perchlorate, Metals, CN
MW11	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, Pest, GChem	VOCs, SVOCs, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, Perchlorate, Metals, CN, Pest	VOCs, SVOCs, 1,4-D, Perchlorate, Metals, CN, Pest	VOCs, Perchlorate, Metals, CN, GChem	VOCs, Perchlorate, Metals, CN	VOCs, Perchlorate, Metals, CN

Notes:

- 1) GChem compounds include TDS, TOC, alkalinity, anions
 2) ---- No sample was collected as the well was not constructed at this time

Abbreviations:

VOCs = volatile organic compounds
 SVOCs = semi-volatile organic compounds
 1,4-D = 1,4-dioxane
 CN = total cyanide
 TOC = total organic carbon
 TDS = total dissolved solids
 Gchem = general chemistry analytes
 Pest = pesticides and polychlorinated biphenyls

Table 2-4

CH2M HILL Groundwater Monitoring Schedule
Omega Chemical Superfund Site

Well	1st QTR 2004 Mar 2 to Mar 5	2nd QTR 2004 Jun 15 to Jun 24	3rd QTR 2004 Sep 13 to Sep 16	4th QTR 2004 Nov 30 to Dec 9	1st QTR 2005 Feb 28 to Mar 3	3rd QTR 2005 Aug 30 to Sep 2	1st QTR 2006 Mar 6 to Mar 15	3rd QTR 2006 Aug 28 to Sep 11	1st QTR 2007 Feb 26 to Mar 7	3rd QTR 2007 Jul 9 to Jul 26
OPOG Monitoring Wells										
OW1A	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)
OW1B	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)
OW2	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)
OW3A	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)
OW3B	-----	-----	-----	-----	-----	-----	X (CDM)	X (CDM)	X (CDM)	X (CDM)
OW4A	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)
OW4B	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)
OW5	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)
OW6	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)
OW7	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)
OW8A	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)
OW8B ¹	-----	-----	X (CDM)	VOCs, SVOCs, Emergents, Metals, CN, GChem	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)	X (CDM)
EPA Monitoring Wells										
MW1A	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr+6, 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW1B	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr+6, 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW2	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr+6, 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents

Table 2-4

CH2M HILL Groundwater Monitoring Schedule
Omega Chemical Superfund Site

Well	1st QTR 2004 Mar 2 to Mar 5	2nd QTR 2004 Jun 15 to Jun 24	3rd QTR 2004 Sep 13 to Sep 16	4th QTR 2004 Nov 30 to Dec 9	1st QTR 2005 Feb 28 to Mar 3	3rd QTR 2005 Aug 30 to Sep 2	1st QTR 2006 Mar 6 to Mar 15	3rd QTR 2006 Aug 28 to Sep 11	1st QTR 2007 Feb 26 to Mar 7	3rd QTR 2007 Jul 9 to Jul 26
MW3	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW4A	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW4B	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW4C	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW5	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW6	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW7	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW8A	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW8B	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW8C	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW8D	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW9A ²	Dry Well	Dry Well	Dry Well	Dry Well	Dry Well	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW9B	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW10	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, 1,4-D, Cr ⁶ , 1,2,3-TCP, NDMA	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW11 ³	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	VOCs, SVOCs, Emergents, Metals, CN, GChem	Dry Well	Dry Well	VOCs, Emergents	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW12	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁶	VOCs, Emergents
MW13A	-----	-----	-----	-----	-----	-----	Dry Well	Dry Well	Dry Well	Dry Well

Table 2-4
CH2M HILL Groundwater Monitoring Schedule
Omega Chemical Superfund Site

Well	1st QTR 2004 Mar 2 to Mar 5	2nd QTR 2004 Jun 15 to Jun 24	3rd QTR 2004 Sep 13 to Sep 16	4th QTR 2004 Nov 30 to Dec 9	1st QTR 2005 Feb 28 to Mar 3	3rd QTR 2005 Aug 30 to Sep 2	1st QTR 2006 Mar 6 to Mar 15	3rd QTR 2006 Aug 28 to Sep 11	1st QTR 2007 Feb 26 to Mar 7	3rd QTR 2007 Jul 9 to Jul 26
MW13B	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW14	-----	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW15	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW16A	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW16B	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW16C	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW17A	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW17B	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW17C	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW18A	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW18B	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW18C	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW19	-----	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW20A	-----	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW20B	-----	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW20C	-----	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW21	-----	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents

Table 2-4

CH2M HILL Groundwater Monitoring Schedule
Omega Chemical Superfund Site

Well	1st QTR 2004 Mar 2 to Mar 5	2nd QTR 2004 Jun 15 to Jun 24	3rd QTR 2004 Sep 13 to Sep 16	4th QTR 2004 Nov 30 to Dec 9	1st QTR 2005 Feb 28 to Mar 3	3rd QTR 2005 Aug 30 to Sep 2	1st QTR 2006 Mar 6 to Mar 15	3rd QTR 2006 Aug 28 to Sep 11	1st QTR 2007 Feb 26 to Mar 7	3rd QTR 2007 Jul 9 to Jul 26
MW22	-----	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW23A	-----	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW23B	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW23C	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW23D	-----	-----	-----	-----	-----	-----	VOCs, Emergents	VOCs, Emergents	VOCs, 1,4-D, Cr ⁺⁶	VOCs, Emergents
MW24A	-----	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW24B	-----	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW24C	-----	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW24D	-----	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW25A	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, 1,4-D, Cr ⁺⁶	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW25B	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, 1,4-D, Cr ⁺⁶	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW25C	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, 1,4-D, Cr ⁺⁶	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW25D	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, 1,4-D, Cr ⁺⁶	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW26A	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, 1,4-D, Cr ⁺⁶	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW26B	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, 1,4-D, Cr ⁺⁶	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW26C	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, 1,4-D, Cr ⁺⁶	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW26D	-----	-----	-----	-----	-----	-----	-----	-----	VOCs, 1,4-D, Cr ⁺⁶	VOCs, SVOCs, Emergents, Metals, CN, GChem

Table 2-4

CH2M HILL Groundwater Monitoring Schedule
Omega Chemical Superfund Site

Well	1st QTR 2004 Mar 2 to Mar 5	2nd QTR 2004 Jun 15 to Jun 24	3rd QTR 2004 Sep 13 to Sep 16	4th QTR 2004 Nov 30 to Dec 9	1st QTR 2005 Feb 28 to Mar 3	3rd QTR 2005 Aug 30 to Sep 2	1st QTR 2006 Mar 6 to Mar 15	3rd QTR 2006 Aug 28 to Sep 11	1st QTR 2007 Feb 26 to Mar 7	3rd QTR 2007 Jul 9 to Jul 26
MW27A	----	----	----	----	----	----	----	----	----	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW27B	----	----	----	----	----	----	----	----	----	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW27C	----	----	----	----	----	----	----	----	----	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW27D	----	----	----	----	----	----	----	----	----	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW28	----	----	----	----	----	----	----	----	----	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW29	----	----	----	----	----	----	----	----	----	VOCs, SVOCs, Emergents, Metals, CN, GChem
MW30	----	----	----	----	----	----	----	----	----	VOCs, SVOCs, Emergents, Metals, CN, GChem

Notes:

1) Emergent compounds include 1,4-dioxane, Cr+6, perchlorate, NDMA, 1,2,3-TCP

2) GChem compounds include alkalinity (total and bicarbonate), ammonia, BOD, boron, COD, silica, TKN, total phosphorous, TDS, TOC, and anions (bromide, chloride, fluoride, nitrate-nitrogen, nitrite-nitrogen, orthophosphate-phosphorous, sulfate)

3) Metals (dissolved) include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, vanadium, zinc, boron, silicon

4) ---- No sample was collected as the well was not constructed at this time

Abbreviations:

VOCs = volatile organic compounds

SVOCs = semi-volatile organic compounds

1,4-D = 1,4-dioxane

Cr+6 = hexavalent chromium

NDMA = n-nitrosodimethylamine

1,2,3-TCP = 1,2,3-trichloropropane

BOD = biological oxygen demand

COD = chemical oxygen demand

CN = total cyanide

TOC = total organic carbon

TKN = total Kjeldahl nitrogen

TDS = total dissolved solids

Gchem = general chemistry analytes

CDM = Camp Dresser and McKee

Table 2-5

Analytical Parameters and Assigned Laboratories

Omega Chemical Superfund Site

Laboratory	Organics		Inorganics			Emergent Compounds					General Chemistry		
	VOCs plus MTBE	SVOCs	Dissolved Metals (Al, Ca, Mg, K, Na)	Dissolved Metals ¹	Total Cyanide	1,4-Dioxane	Perchlorate	1,2,3-TCP	NDMA	Cr ⁺⁶	Anions ²	TDS, Alkalinity, Total phosphorous, TKN, BOD, TOC	COD
1st QTR 2004 - March 2 to March 5													
EPA Region 9						X	X	X			X	X	
Shealy	X	X											
Ceimic			X	X	X								
MWH									X				X
EMAX										X			
2nd QTR 2004 - June 15 to June 24													
EPA Region 9						X	X				X	X	
Shealy	X	X											
Ceimic			X	X	X								
STL								X	X				X
APCL										X			
3rd QTR 2004 - September 13 to September 16													
EPA Region 9						X	X				X	X	
Shealy	X	X											
Ceimic			X	X	X								
STL								X	X				X
APCL										X			
4th QTR 2004 - November 30 to December 9													
EPA Region 9						X	X				X	X	
Shealy	X	X											
Ceimic			X										
Sentinel				X	X								
STL								X	X				X
APCL										X			
1st QTR 2005 - February 28 to March 3													
EPA Region 9						X							
Shealy	X												
STL								X	X				
APCL	X									X			
3rd QTR 2005 - August 30 to September 2													
EPA Region 9						X	X						
STL								X	X				
APCL										X			
A4 Scientific	X												
1st QTR 2006 - March 6 to March 15													
EPA Region 9	X					X	X						

Table 2-5

Analytical Parameters and Assigned Laboratories

Omega Chemical Superfund Site

Laboratory	Organics		Inorganics			Emergent Compounds					General Chemistry		
	VOCs plus MTBE	SVOCs	Dissolved Metals (Al, Ca, Mg, K, Na)	Dissolved Metals ¹	Total Cyanide	1,4-Dioxane	Perchlorate	1,2,3-TCP	NDMA	Cr ⁺⁶	Anions ²	TDS, Alkalinity, Total phosphorous, TKN, BOD, TOC	COD
APCL								X	X	X			
3rd QTR 2006 - August 28 to September 11													
EPA Region 9	X					X	X						
Test America								X	X	X			
1st QTR 2007 - February 28 to March 7													
Test America										X			
Mitkem	X					X							
3rd QTR 2007 - July 9 to July 26													
EPA							X				X	X	
Shealy	X	X				X							
Bonner			X	X	X								
Test America								X	X	X			X

Notes:

¹ Dissolved metals include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc, boron, silicon

² Anions include bromide, chloride, fluoride, nitrate-nitrogen, nitrite-nitrogen, orthophosphate-phosphorous, sulfate

X

Indicates that a particular analyte was analyzed by the selected laboratory

Abbreviations:

VOCs - volatile organic carbon
 MTBE - methyl-tert-butyl-ether
 SVOCs - semivolatile organic carbon
 Al - aluminum
 Ca - calcium
 Mg - magnesium
 K - potassium
 Na - sodium
 1,2,3-TCP - 1,2,3-trichloropropane
 NDMA - N-nitrosodimethylamine
 Cr+6 - hexavalent chromium
 TDS - total dissolved solids
 TKN - total kjeldahl nitrogen
 BOD - biological oxygen demand
 TOC - total organic carbon
 COD - carbonaceous oxygen demand

Laboratory Abbreviations:

EPA Region 9 - EPA Region 9 Laboratory
 Shealy - Shealy Environmental Services (EPA contract lab program)
 Ceimic - Ceimic Corporation (EPA contract lab program)
 Sentinel - Sentinel, Inc. (EPA contract lab program)
 A4 - A4 Scientific (EPA contract lab program)
 Bonner - Bonner Analytical Testing (EPA contract lab program)
 STL - Severn Trent Laboratories Sacramento (U.S. Army Corp of Engineers contract lab)
 APCL - APC Laboratories (U.S. Army Corp of Engineers contract lab)
 Test America - (U.S. Army Corp of Engineers contract lab)
 MWH - MWH Laboratories (CH2M HILL contract lab)
 EMAX - EMAX Laboratories (CH2M HILL contract lab)

Table 2-6
Summary of Detections from WDC's Water Truck
Omega Chemical Superfund Site

DRAFT

Sample ID			OC2-MW24HY-W-0-560	OC2-HYD1-W-0-461	OC2-HYD-W-0-443
Sample Location			MW24 Hydrant	MW26 Hydrant	MW27 Hydrant
Sample Date			6/1/2007	2/26/2007	4/11/2007
Analyte	Screening Level	Units	Analytical Results		
Emergents					
1,4-Dioxane (p-dioxane)	3	µg/L	---	3.4 J	---
Volatile Organics					
Bromodichloromethane	80	µg/L	0.3 J	0.83 J	12
Bromoform	80	µg/L	5.3 J	13 J	4.9
Chloroform	80	µg/L	---	---	9.1
Dibromochloromethane	80	µg/L	1.3	4.4 J	11
Trichloroethene	5	µg/L	---	0.22 J	---
Total Volatile Organics					
TVOC	NE	µg/L	6.9	18.45	37

Notes:

Sample depth in feet below ground surface.
Bold indicates result is above screening level.
ND (250) = Not detected above listed reporting limit.
-- = Not detected or not analyzed.
J = Estimated value
R = Rejected
ug/L = micrograms per Liter

Table 2-7
Summary of VOCs Detections, Discrete-Depth Simulprobe Samples
Omega Chemical Superfund Site

DRAFT

Sample ID			OC2-	OC2-	OC2-	OC2-	OC2-
			MW24DD60-W-0-553	MW24DD60-W-1-554	MW24DD80-W-0-555	MW24DD140-W-0-557	MW24DD155-W-0-558
Sample Location			MW24	MW24	MW24	MW24	MW24
			Discrete Depth	Discrete Depth	Discrete Depth	Discrete Depth	Discrete Depth
Sample Date			5/29/2007	5/29/2007	5/30/2007	5/31/2007	6/1/2007
Analyte	Screening Level	Units	Analytical Results				
Volatile Organics							
1,1,1-Trichloroethane	200	µg/L	ND (0.50)	ND (0.50)	1.5	ND (0.50)	ND (0.50)
1,1,2-Trichloro-1,2,2-trifluoroethane	1200	µg/L	96 J	90	1,400	2.9	ND (0.50)
1,1,2-Trichloroethane	5	µg/L	ND (0.50)	ND (0.50)	2.7	ND (0.50)	ND (0.50)
1,1-Dichloroethane	5	µg/L	ND (0.50)	ND (0.50)	10	ND (0.50)	ND (0.50)
1,1-Dichloroethene	6	µg/L	66 J	65	2,400	ND (0.50)	ND (0.50)
1,2-Dichloroethane	0.5	µg/L	ND (0.50)	ND (0.50)	68	ND (0.50)	ND (0.50)
Benzene	1	µg/L	ND (0.50)	ND (0.50)	3	ND (0.50)	ND (0.50)
Bromodichloromethane	80	µg/L	0.3 J	0.3 J	4.1	ND (0.50)	ND (0.50)
Carbon tetrachloride	0.5	µg/L	ND (0.50)	ND (0.50)	0.3 J	ND (0.50)	ND (0.50)
Chlorobenzene	70	µg/L	ND (0.50)	ND (0.50)	0.3 J	ND (0.50)	ND (0.50)
Chloroform	80	µg/L	7.5	7.9	820	ND (0.50)	ND (0.50)
cis-1,2-Dichloroethene	6	µg/L	ND (0.50)	ND (0.50)	5.4	ND (0.50)	ND (0.50)
Dibromochloromethane	80	µg/L	0.2 J	0.2 J	ND (0.50)	ND (0.50)	ND (0.50)
Dichlorodifluoromethane (Freon 12)	1000	µg/L	ND (0.50)	ND (0.50)	3	ND (0.50)	ND (0.50)
Methyl ethyl ketone	NE	µg/L	4.9 J	ND (4.00)	ND (4.00) J	ND (4.00) J	ND (4.00) J
Methyl tert-butyl ether	13	µg/L	ND (2.00)	ND (2.00)	2.4	ND (2.00)	ND (2.00)
Methylene chloride	5	µg/L	ND (0.50)	ND (0.50)	0.6	ND (0.50)	ND (0.50)
Tetrachloroethene	5	µg/L	65 J	61	3,800	0.4 J	0.6
trans-1,2-Dichloroethene	10	µg/L	ND (0.50)	ND (0.50)	7	ND (0.50)	ND (0.50)
Trichloroethene	5	µg/L	12	12	610	1	ND (0.50)
Trichlorofluoromethane (Freon 11)	150	µg/L	45 J	40	620	1.4	ND (0.50)
Vinyl chloride	0.5	µg/L	ND (0.50)	ND (0.50)	0.3 J	ND (0.50)	ND (0.50)
Total Volatile Organics							
TVOC	NE	µg/L	296.9	276.4	9,759	5.7	0.6

Notes:

Sample depth in feet below ground surface.
Bold indicates result is above screening level.
ND (250) = Not detected above listed reporting limit.
-- = Not detected or not analyzed.
J = Estimated value
R = Rejected
ug/L = micrograms per Liter

Table 2-8
 Slug Test Field Data Summary
 Omega Chemical Superfund Site

Well	Test Date	Phase	Slug OD (inches)	Slug Length (feet)	Volume of Water Displaced by Slug (ft ³)	No. Rising Tests	No. Falling Tests	Casing ID (inches)
OW3B	5/15/2006	1	2.36	10	6.18	2	2	3.998
OW3B	5/23/2006	1	2.36	10	6.18	1	1	3.998
OW3B	5/23/2006	1	2.36	15	9.27	1	1	3.998
OW4A	5/17/2006	1	2.36	10	6.18	2	2	4.026
OW4B	5/17/2006	1	2.36	10	6.18	2	2	4.026
OW5	5/24/2006	1	2.36	10	6.18	2	2	3.998
OW6	5/19/2006	1	2.36	10	6.18	2	2	4.026
OW7	5/18/2006	1	2.36	10	6.18	2	2	4.026
OW8B	5/17/2006	1	2.36	10	6.18	2	2	3.998
MW1A	5/23/2006	1	2.36	10	6.18	2	2	3.998
MW1B	5/23/2006	1	2.36	10	6.18	2	2	3.998
MW2	5/24/2006	1	2.36	10	6.18	2	2	3.998
MW2	5/24/2006	1	2.36	15	9.27	1	1	3.998
MW3	5/18/2006	1	2.36	10	6.18	2	2	3.998
MW4A	5/19/2006	1	2.36	10	6.18	2	2	3.998
MW4B	5/19/2006	1	1.30	15	5.11	2	2	2.049
MW4C	5/19/2006	1	1.30	15	5.11	2	2	2.049
MW5	5/24/2006	1	2.36	10	6.18	2	2	3.998
MW6	5/23/2006	1	2.36	10	6.18	2	2	3.998
MW7	5/18/2006	1	2.36	10	6.18	2	2	3.998
MW8A	5/16/2006	1	2.36	5	3.09	4	4	3.998
MW8B	5/16/2006	1	1.30	15	5.11	2	2	2.049
MW8C	5/16/2006	1	1.30	15	5.11	3	3	2.049
MW8D	5/16/2006	1	2.36	10	6.18	3	3	3.998
MW9A	5/24/2006	1	2.36	5	3.09	2	2	3.998
MW9B	5/16/2006	1	2.36	10	6.18	2	2	3.998
MW10	5/23/2006	1	2.36	10	6.18	2	2	3.998
MW11	5/18/2006	1	2.36	10	6.18	2	2	3.998
MW12	8/7/2006	2	1.30	15	5.11	2	3	1.913
MW13B	5/15/2006	1	1.30	15	5.11	3	3	1.913
MW14	8/9/2006	2	1.30	15	5.11	3	3	1.913
MW15	5/24/2006	1	1.30	15	5.11	3	3	1.913
MW16A	5/18/2006	1	1.30	10	3.40	2	2	1.913
MW16B	8/7/2006	2	1.30	15	5.11	2	2	1.913
MW16C	8/7/2006	2	1.30	15	5.11	2	2	1.913
MW17A	8/9/2006	2	1.30	10	3.40	2	2	1.913
MW-17B	8/9/2006	2	1.30	15	5.11	3	3	1.913
MW17C	8/9/2006	2	1.30	15	5.11	3	3	1.913
MW18A	5/17/2006	1	1.30	15	5.11	2	2	1.913
MW18B	5/17/2006	1	1.30	15	5.11	3	3	1.913
MW18C	5/17/2006	1	1.30	15	5.11	2	2	1.913
MW20A	8/8/2006	2	1.30	15	5.11	2	2	1.913
MW20B	8/8/2006	2	1.30	15	5.11	2	2	1.913
MW20C	8/8/2006	2	1.30	15	5.11	2	2	1.913
MW21	8/8/2006	2	1.30	15	5.11	2	2	1.913
MW22	8/8/2006	2	1.30	15	5.11	2	2	1.913
MW23A	6/19/2007	4	2.36	15	9.27	2	2	3.786
MW23B	5/15/2006	1	1.30	15	5.11	2	2	1.913
MW23C	5/15/2006	1	1.30	15	5.11	3	3	1.913
MW23D	5/15/2006	1	1.30	15	5.11	2	2	1.913
MW24A	6/18/2007	4	2.36	15	9.27	2	2	3.786
MW24B	6/18/2007	4	1.30	15	5.11	2	2	1.913
MW24C	6/18/2007	4	2.36	15	9.27	2	2	3.786
MW24D	6/18/2007	4	1.30	15	5.11	2	2	1.913
MW25A	5/1/2007	3	2.36	15	9.27	2	4	3.786
MW25B	5/1/2007	3	1.30	15	5.11	2	2	1.913
MW25C	5/1/2007	3	2.36	15	9.27	2	2	3.786
MW25D	5/1/2007	3	1.30	15	5.11	2	2	1.913
MW26A	5/2/2007	3	2.36	15	9.27	2	2	3.786
MW26B	5/2/2007	3	1.30	15	5.11	2	2	1.913
MW26C	5/2/2007	3	1.30	15	5.11	2	2	1.913

Table 2-8

Slug Test Field Data Summary
Omega Chemical Superfund Site

Well	Test Date	Phase	Slug OD (inches)	Slug Length (feet)	Volume of Water Displaced by Slug (ft ³)	No. Rising Tests	No. Falling Tests	Casing ID (inches)
MW26D	5/2/2007	3	1.30	15	5.11	2	2	1.913
MW27A	5/3/2007	3	2.36	15	9.27	2	2	3.786
MW27B	5/3/2007	3	2.36	15	9.27	3	3	3.786
MW27C	5/2/2007	3	1.30	15	5.11	2	2	1.913
MW27D	5/2/2007	3	1.30	15	5.11	2	2	1.913
MW28	6/19/2007	4	2.36	15	9.27	2	2	3.786
MW29	6/19/2007	4	2.36	15	9.27	2	2	3.786
MW30	6/19/2007	4	2.36	15	9.27	2	2	3.786

Notes:

ID - inside diameter

OD - outside diameter

Table 2-9
Summary of Step-Testing Field Data - Monitoring Wells
Omega Chemical Superfund Site

Date		Well	Static DTW (feet bgs)	Pressure Transducer Depth (feet bgs)	Head Above Pressure Transducer (feet)	Pressure Transducer Recording Frequency	Casing Diameter (inches)	Pump Diameter (inches)	Step	Flow Rate (gpm)	Duration (minutes)	Discharge (gallons)
19-Jun-07	Observation Well	MW23C	31.73	56.29	18.89	1 minute	2	---	---	---	---	---
	Observation Well	MW23D	32.55	44.49	17.93	1 minute	2					
20-Jun-07	Pump Well	MW27B	76.75	100.55	23.8	1 second	4	3	1	7.4	62	480
	Observation Well	MW27A	76.91	101.47	24.56	1 minute	4		2	15.4	60	950
	Observation Well	MW27C	88.92	100.86	11.94	1 minute	2		3	20.7	78	1647
								4	23.6	58	1335	
									Total		258	4412
21-Jun-07	Pump Well	MW27A	76.88	101.2	24.32	1 second	4	3	1	5.5	65	366
	Observation Well	MW27B	76.71	100.45	23.74	1 minute	4		2	13.7	57	784
	Observation Well	MW27C	89.03	100.79	11.76	1 minute	2		3	19.5	60	1174
								4	23.8	120	2826	
									Total		302	5150
22-Jun-07	Pump Well	MW26B	67.02	100.65	33.63	1 second	2	2	1	1	30	34
	Observation Well	MW26A	66.95	87.03	20.08	1 minute	4		2	2.2	61	109
	Observation Well	MW26C	78.99	101.27	22.28	1 minute	4		3	3	60	182
								4	4.7	60	295	
									Total		211	620
25-Jun-07	Pump Well	MW26A	66.99	87.99	21	1 second	4	3	1	5	60	300
	Observation Well	MW26B	67.05	100.72	33.67	1 minute	2		2	10.3	60	640
	Observation Well	MW26C	78.72	100.2	21.48	1 minute	4		3	15	60	860
								4	19.8	60	1151	
								5	27.5	120	3349	
									Total		360	6300
26-Jun-07	Pump Well	MW24C	41.72	84.62	42.9	1 second	4	3	1	5.3	60	315
	Observation Well	MW24B	41.38	76.58	35.2	1 minute	2		2	14.9	60	895
	Observation Well	MW24D	42.09	71.92	29.83	1 minute	2		3	20	60	1200
								4	29.4	135	3977	
									Total		315	6387
28-Jun-07	Pump Well	MW24A	36.9	62.82	25.92	1 second	4	3	1	5.1	60	310
	Observation Well	MW24B	41.42	76.44	35.02	1 minute	2		2	12.3	60	719
								3	20.3	60	1251	
								4	31.4	120	3720	
									Total		300	6000
29-Jun-07	Pump Well	MW23A	27.9	48.56	20.66	1 second	4		1	5.5	60	330
	Observation Well	MW23B	n/a	n/a	41.32	1 minute	2		2	13.2	70	935
								3	20.2	60	1165	
								4	34.8	110	3830	
									Total		300	6260
2-Jul-07	Pump Well	MW30	92.58	110.44	17.86	1 second	4		1	5.5	80	430
									2	11.4	57	640
									3	19.8	61	1212
								4	26.6	88	2360	
									Total		286	4642

Notes:
feet bgs -feet below ground surface
DTW - depth to water
gpm - gallons per minute
n/a - information not available
---- not applicable

Table 2-10
Soil Gas Probe Completion Details
Omega Chemical Superfund Site

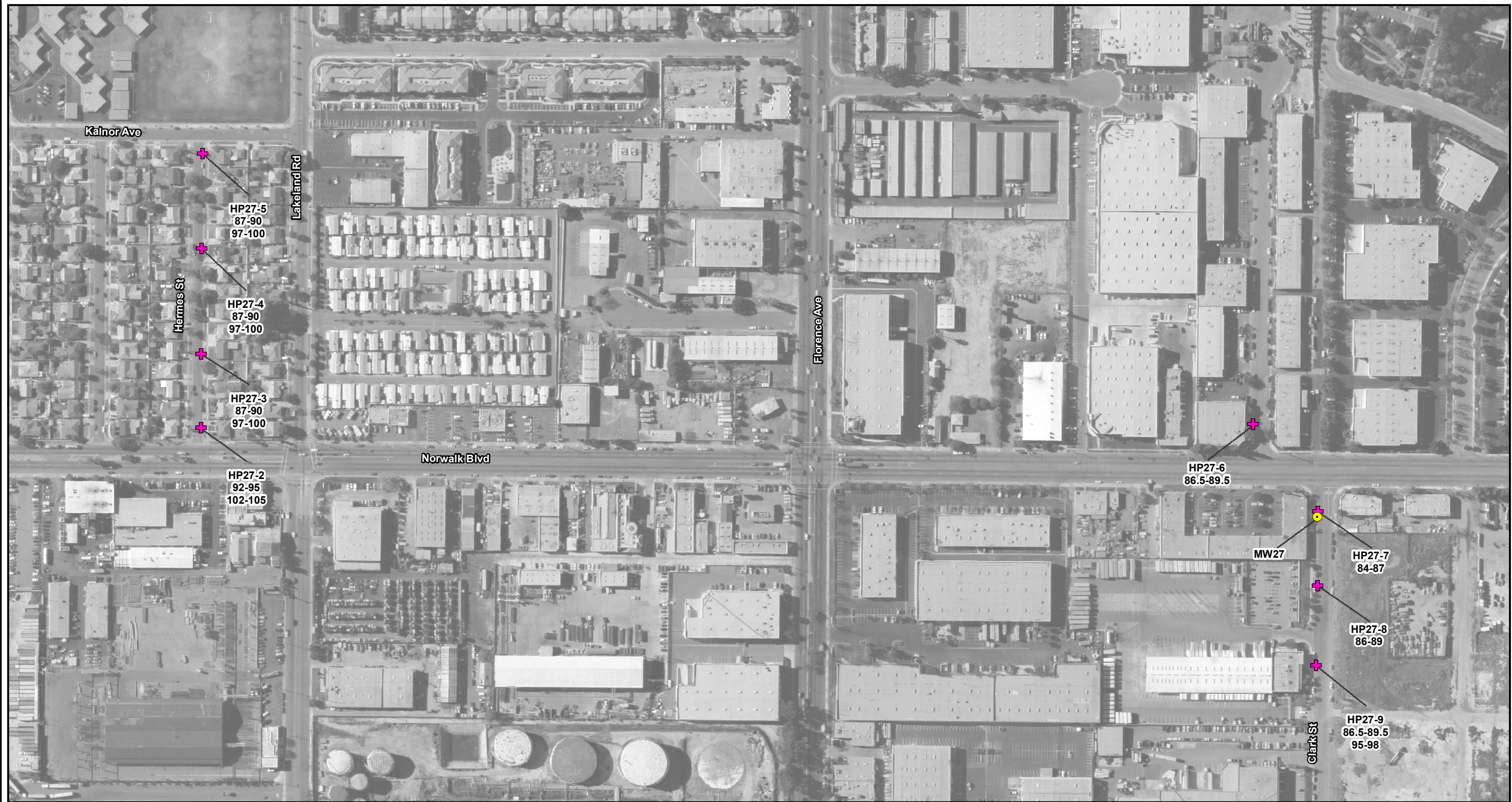
Probe ID	Northing	Easting	Drilling Method	Borehole Diameter (inches)	TD of Borehole (ft bgs)	Tubing Depth (ft bgs)	Tubing Diameter (inches)	Tubing Material	Screen Material	Screen Interval		Filter Pack Material	Filter Pack Interval		Annular Seal	Annular Seal Interval	
										From	To		From	To		From	To
SGRA1A	3759066.602	402901.838	Direct Push	2.5	32.5	12.5	0.25	Polyethylene	SST	12.5	13	#3 Sand	12	13.5	granular bentonite (dry) medium chips (hydrated) granular bentonite (dry) #60 transition sand	1 4 10.5 11.5	4 10.5 11.5 12
SGRA1B	3759066.602	402901.838	Direct Push	2.5	32.5	21.5	0.25	Polyethylene	SST	21.5	22	#3 Sand	21	22.5	medium chips (hydrated) granular bentonite (dry) #60 transition sand	13.5 19.5 20.5	19.5 20.5 21
SGRA1C	3759066.602	402901.838	Direct Push	2.5	32.5	31.5	0.25	Polyethylene	SST	31.5	32	#3 Sand	31	32.5	medium chips (hydrated) granular bentonite (dry) #60 transition sand	22.5 29.5 30.5	29.5 30.5 31
SGRA2A	3759093.890	402839.001	Direct Push	2.5	30	7	0.25	Polyethylene	SST	7	7.5	#3 Sand	6.5	8	granular bentonite (dry) medium chips (hydrated) granular bentonite (dry) #60 transition sand	1 4 5 6	4 5 6 6.5
SGRA2B	3759093.890	402839.001	Direct Push	2.5	30	12.5	0.25	Polyethylene	SST	12.5	13	#3 Sand	12	13.5	medium chips (hydrated) granular bentonite (dry) #60 transition sand	8 10.5 11.5	10.5 11.5 12
SGRA2C	3759093.890	402839.001	Direct Push	2.5	30	28.5	0.25	Polyethylene	SST	28.5	29	#3 Sand	28	30	medium chips (hydrated) granular bentonite (dry) #60 transition sand	13.5 26.5 27.5	26.5 27.5 28
SGRA3A	3759191.470	402874.101	Direct Push	2.5	30	11.5	0.25	Polyethylene	SST	11.5	12	#3 Sand	11	12.5	granular bentonite (dry) medium chips (hydrated) granular bentonite (dry) #60 transition sand	1 4 10 10.5	4 10 10.5 11
SGRA3B	3759191.470	402874.101	Direct Push	2.5	30	18.5	0.25	Polyethylene	SST	18.5	19	#3 Sand	18	19.5	medium chips (hydrated) granular bentonite (dry) #60 transition sand	12.5 17 17.5	17 17.5 18
SGRA3C	3759191.470	402874.101	Direct Push	2.5	30	28.5	0.25	Polyethylene	SST	28.5	29	#3 Sand	28	30	medium chips (hydrated) granular bentonite (dry) #60 transition sand	19.5 27 27.5	27 27.5 28
SGRA4A	3759152.545	402962.721	Direct Push	2.5	31.5	10.5	0.25	Polyethylene	SST	10.5	11	#3 Sand	10	11.5	granular bentonite (dry) medium chips (hydrated) granular bentonite (dry) #60 transition sand	1 4 8.5 9.5	4 8.5 9.5 10
SGRA4B	3759152.545	402962.721	Direct Push	2.5	31.5	18	0.25	Polyethylene	SST	18	18.5	#3 Sand	17.5	19	medium chips (hydrated) granular bentonite (dry) #60 transition sand	11.5 16 17	16 17 17.5
SGRA4C	3759152.545	402962.721	Direct Push	2.5	31.5	30.5	0.25	Polyethylene	SST	30.5	31	#3 Sand	30	31.5	medium chips (hydrated) granular bentonite (dry) #60 transition sand	19 28.5 29.5	28.5 29.5 30

Notes:

ft bgs = feet below ground surface

SST = stainless steel

Northing and easting coordinates are referenced to UTM (meters) Zone 11, NAD83



Legend

- + Hydropunch
- MW27
- 32-35 Depth of Hydropunch
(Feet below Ground Surface)






0 250 500 Feet

Figure 2-2
Well MW27 Hydropunch
Boring Locations
Omega Chemical Superfund Site



LEGEND

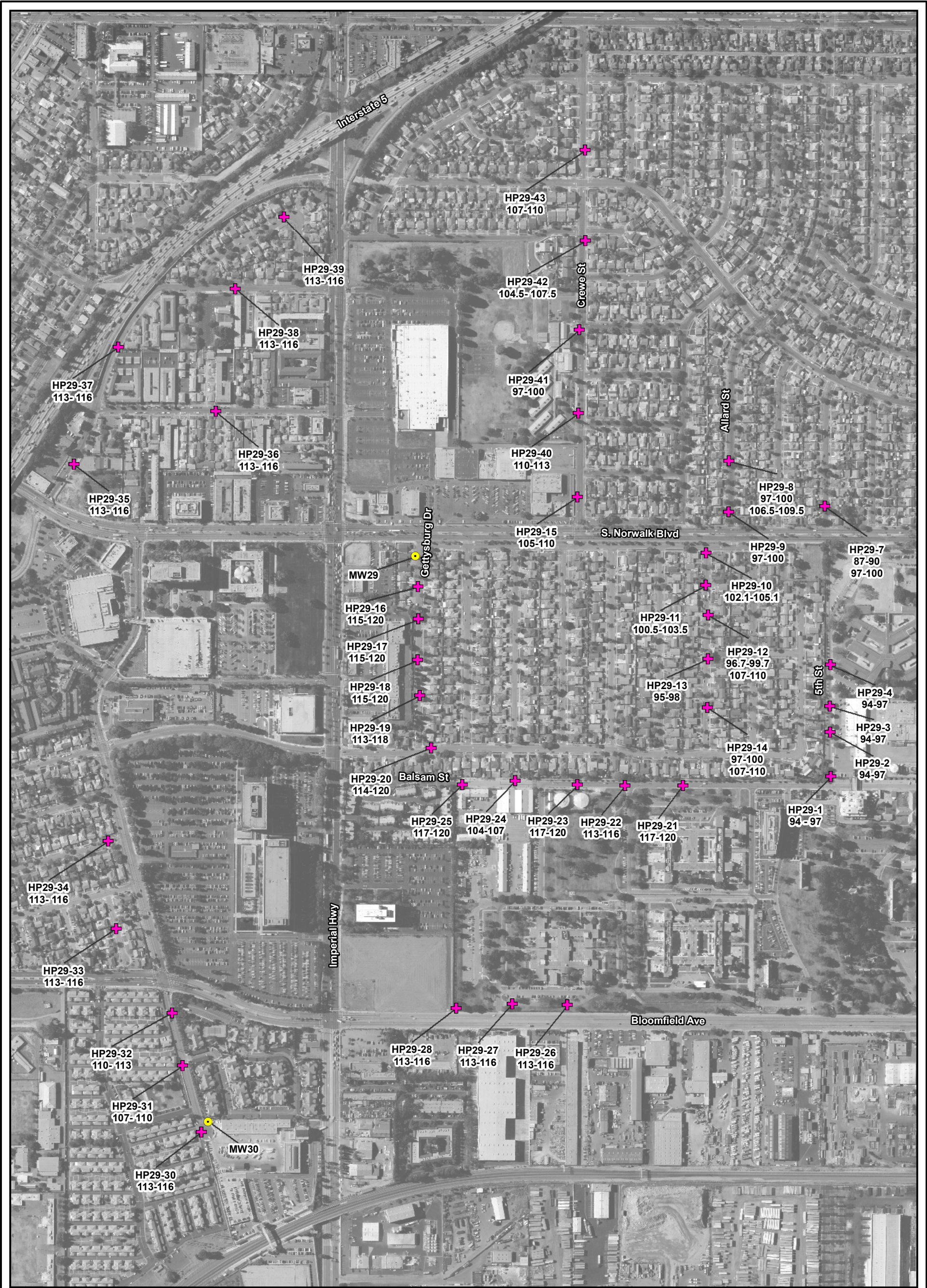
-  Hydropunch
-  MW28
-  Depth of Hydropunch Sample (Feet below ground surface)

32-35



0 75 150 Feet

Figure 2-3
Well MW28 Hydropunch
Boring Location
Omega Chemical Superfund Site



LEGEND

- Hydropunch
- MW29 and MW30
- 32-35 Depth of Hydropunch Sample (Feet below ground surface)

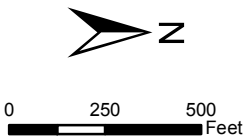





Figure 2-4
Wells MW29 and MW30
Hydropunch Boring Location
Omega Chemical Superfund Site



LEGEND

-  Hydropunch
-  EPA Monitoring Well
-  Facility Boundary
- Depth of Sample
32-35
(Feet below ground surface)

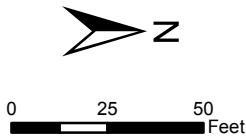


Figure 2-5
Site D
Hydropunch Location Map
Omega Chemical Superfund Site



Legend

- + Hydropunch
- Facility Boundary
- 32-35 Depth of Hydropunch
(Feet below Ground Surface)



0 62.5 125 Feet

Figure 2-6
Site E
Hydropunch Location Map
Omega Chemical Superfund Site



Legend

- + Hydropunch
- EPA Monitoring Well
- Facility Boundary
- 32-35 Depth of Hydropunch
(Feet below Ground Surface)



0 75 150 Feet

Figure 2-7
Former Earl Manufacturing
Hydropunch Location Map
 Omega Chemical Superfund Site



LEGEND

- Hypopunch
- Facility Boundary
- Depth of Hypopunch Sample
(Feet below ground surface)

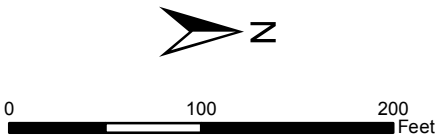
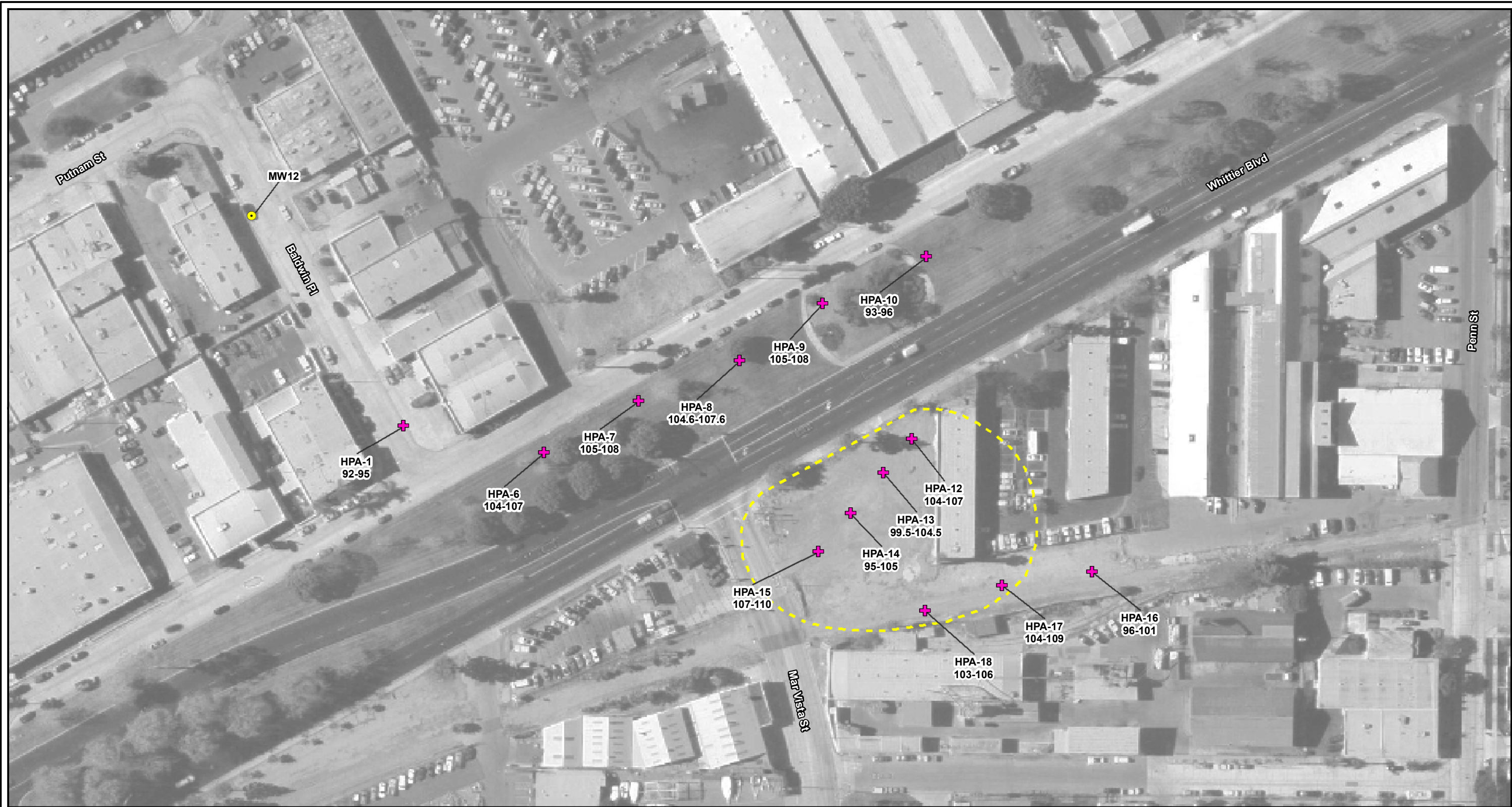


Figure 2-8
Site F
Hypopunch Location Map
Omega Chemical Superfund Site



Legend

- + Hydropunch
- EPA Monitoring Well
- Approximate Potential Source Area
- 32-35 Depth of Hydropunch
(Feet below Ground Surface)



0 100 200 Feet

Figure 2-9
TCE Source Area at Whittier Blvd
Hydropunch Location Map
 Omega Chemical Superfund Site



LEGEND

- Hypopunch
- Soil Gas Probe
- Soil Sample
- EPA Monitoring Well
- Approximate Residential Area Boundary
- Depth of Hypopunch Sample (Feet below ground surface)

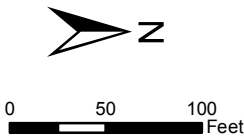


Figure 2-10
Residential Area Sample
Location Map
Omega Chemical Superfund Site

3. Data Quality

This section provides a summary of the results of the evaluation of the QC and QA activities employed to ensure that the conclusions and recommendations presented in this RI report are supported by chemical data of known, acceptable, and documented quality. These QC and QA activities included:

- Preparation and analysis of field QC samples including field blanks, equipment rinsate blanks, and field duplicates
- Evaluation of precision and accuracy through data review and validation

Based on the evaluation of the available QC and QA information, the 90 percent completeness goal was achieved for all analyses based on a ratio of the number of usable results (data not rejected due to serious deficiencies) to the total number of results. A small number of samples was rejected representing approximately 1 percent of the total number of results. The overall findings of the data review and validation indicate that the data are of sufficient quality to support the goals of the RI.

3.1 Field Quality Control

Field QC included preparation of field blanks, equipment rinsate blanks, trip blanks, and field duplicates.

3.1.1 Blanks

During each sampling event, three types of blanks were prepared: field blanks, equipment blanks, and trip blanks. The purpose of these blanks is to verify that contamination is not introduced by sampling techniques, environmental conditions, or during sample shipment or storage. The number and type of blanks prepared are listed in Table 3-1; following is a description of the blanks:

- **Ambient blanks** – These are prepared in the field at the sample collection location to determine if contamination is being introduced from environmental conditions.
- **Equipment blanks** – These are prepared in the field by pouring reagent water over reusable equipment following decontamination to determine the effectiveness of the decontamination process.
- **Trip blanks** – These are prepared at the laboratory from reagent water contained in sealed vials that remain with the samples to determine if contamination is being introduced during collection, shipment, and storage.

Based on the review of the results of the field blanks, there were no significant contamination issues with the exception of one equipment rinsate blank collected during the fourth quarter groundwater sampling in December 2004.

For the fourth quarter December 2004 sampling, field QC samples included three field blanks and one equipment blank. Although it is not unexpected to find common laboratory contaminants in field, equipment, and trip blanks at concentrations near the reporting limit, several target analytes were detected in the equipment blank OC2-OW1A-W-3-84 at concentrations well above the reporting limit. The results for this equipment blank are summarized below:

Sample Identification	Collection Date	Analyte	Results (µg/L)	Detection Limit (µg/L)
OC2-OW1A-W-3-84	12/1/2004	1,1,1-Trichloroethane	1.8	0.5
		1,1,1-Trichloroethane	1.6	0.5
		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	0.4	0.5
		1,1-Dichloroethene	0.45	0.5
		Acetone	7.4	5
		Benzene	0.57	0.5
		Bromomethane	0.15	0.5
		Bromomethane	4.6	0.5
		Carbon disulfide	0.29	0.5
		Chloroform	0.32	0.5
		Chloromethane	1.6	0.5
		N-Nitrosodimethylamine (NDMA)	0.0041	0.002
		Tetrachloroethene (PCE)	140	0.5
		Toluene	0.2	0.5
		Trichloroethene (TCE)	1.1	0.5

The elevated concentrations of PCE and NDMA in the fourth quarter equipment blank can be attributed to contamination of the 2-inch-diameter submersible pump that was used to purge well OW1A. Typically, well OW1A is the last well sampled because of the high concentration of target analytes. Well OW1A was purged on December 1, 2004 before sampling of remaining wells OW1B and OW3. After purging well OW1A, the pump was decontaminated and an equipment blank was collected. The equipment blank results indicate the potential for carry over contamination; however, the results for the samples from wells OW1B and OW3 are consistent with results obtained in previous events and do not appear to be affected by carryover.

As discussed in Appendix A, the results for ambient, equipment, and trip blanks associated with the Omega groundwater and RI sampling events indicate that the procedures used for, and conditions of, sample collection were sufficient to ensure that the results are representative. There were no significant contamination trends, other than discussed in this section, that are expected to have a negative impact on data usability.

3.1.2 Field Duplicates

Field duplicate samples are collocated samples used to evaluate overall reproducibility taking into account both field and analytical variability. The project goal is to collect field

duplicates at a frequency of 10 percent of samples collected. The actual percentage of field duplicates collected is 9.8 percent, slightly less than the project goal.

Field duplicate results are evaluated by comparing the calculated relative percent difference (RPD) to the acceptance criteria specified in Table A-2 of the Omega QAPP. The RPD is calculated as follows:

$$\text{RPD} = \frac{100 * (\text{Primary Result} - \text{Field Duplicate Result})}{\frac{1}{2} * (\text{Primary Result} + \text{Field Duplicate Result})}$$

For the Omega data, the RPD was calculated for pairs of results where an analyte was detected in both the primary and field duplicate samples. If the analyte was not detected in either one or both of the duplicate samples, the RPD was not calculated. In cases where the analyte is not detected or detected in one sample, the results are considered acceptable if the magnitude of the reporting limit or reporting limit and result are of similar magnitude. A summary of the field duplicate outliers is presented in Table 3-2. Appendix A.1 presents all field duplicate results obtained during the groundwater and RI sampling events.

The percent of acceptable results based on comparable duplicate pairs by analytical group is as follows:

- 80 percent of the comparable VOC field duplicate results were within the 30 percent acceptance criterion.
- 90 percent of the comparable 1,4-dioxane field duplicate results were within the 30 percent acceptance criterion.
- 92 percent of the comparable hexavalent chromium field duplicate results were within the 30 percent acceptance criterion.
- 67 percent of the comparable NDMA field duplicate results were within the 30 percent acceptance criterion.
- 96 percent of the comparable perchlorate results were within the 50 percent acceptance criterion.

There were only two comparable sets of field duplicate results for 1,2,3-TCP; the RPD in both cases was 44 percent, which is above the 30 percent project acceptance criterion. The concentrations were below the 0.005 µg/L reporting limit and the absolute concentration difference between the results was small. Because of the small difference between the duplicate concentrations, the field duplicate results do not negatively impact data usability. For the entire field duplicate set, there were 675 comparable results; of these, 89 percent were within project acceptance criteria. Field duplicate results are affected by both analytical precision, field variations, and the difference in sample matrices. While groundwater is generally considered a homogenous matrix, there can be differences depending on the order of sample collection and overall sample handling in the field and the laboratory. These factors are likely responsible for the observed differences.

3.2 Data Review and Validation

In order to document that the collected data were of sufficient quality, data review and validation were performed. Data review included Tier 1 review, both automated and manual, and manual Tier 2 review, described as follows:

- **Tier 1A and Tier 2 Review** – Tier 1A and Tier 2 review are manual reviews of essential QC information without review of raw data. Tier 2 is an expanded review of the data that includes review of additional method QC results such as calibration statistics along with all of the elements of the Tier 1A review. Tier 1A review was applied to the data from the EPA Region 9 Laboratory; both Tier 1A and Tier 2 review were applied to some of the emergent chemical results that were analyzed by laboratories outside the EPA CLP, due to the specialized nature of these test methods.
- **Tier 1B Review** – CLP data review involved application of Computer-Aided Data Review and Evaluation (CADRE) software to perform an automated review.

Data review and validation for both the Tier 1A and Tier 1B approaches considered the QC elements listed below.

- Sample holding times
- Method blanks
- Laboratory control samples
- Continuing calibration standards
- Matrix spikes (MS)
- Sample duplicates and spike duplicates
- Volatile system monitoring compounds
- Internal standards
- Surrogates

Tier 3 Review – Tier 3 validation includes all of the elements of the Tier 1 and Tier 2 reviews along with qualitative and quantitative evaluation of the raw data. The findings of the Tier 3 validation are considered representative of the entire data set and are discussed in detail by event in Appendix A.

Table 3-3 summarizes the overall percentage of samples reviewed by method and validation level. The 10 percent validation goal was achieved for all methods containing site-related analytes. Several of the data packages for emergent chemicals from the 2004 monitoring were not reviewed. Since data from the same laboratories was reviewed according to plan for subsequent events without significant negative findings, the unreviewed data are considered to be of similar quality. This deficiency is not considered to impact the usability of these data.

In order to organize the results of the validation, a systematic set of reason codes is assigned to each qualified result. These reason codes are summarized in Table 3-4 with a description; Table 3-5 presents a list of the number of qualified results by reason code. A complete listing of all qualified data is presented in Appendix A.3.

The estimation of analytical data is based on associated QC results that do not meet the project and/or method specifications. In general, measurement data associated with QC

results that do not meet the project precision and accuracy goals contain more uncertainty than results associated with QC results that meet the project goals. Serious QC deficiencies resulted in rejected data. The rejected data are discussed in Section A1.1 of Appendix A. As can be seen in Table 3-5, the amount of rejected data is small, and sufficient usable data are available to meet the project goals.

The only notable analytical issue was associated with the NDMA analyses. In a number of cases, the data validation narrative indicated that the low point standard (0.005 µg/L) mass spectra were insufficient to support the 0.005 µg/L reporting limit. The recommendation of the data validators is to raise the reporting limit to 0.01 to 0.02 µg/L, specifically when the sample mass spectra did not meet the acceptability criteria. It should be noted that the current project-required reporting limit is equal to the California notification level for NDMA and is at the limit of detection for the best available analytical technology. Since all NDMA results below the reporting limit are qualified as estimated, the reported results and current reporting limit are retained for project use, although the possibility of false negatives should be considered.

3.3 Split Samples

Split samples were collected from wells included in the ARCADIS groundwater monitoring program. The split samples were collected from OU2 monitoring wells MW12, MW13B, and MW 14 in July 2006. Primarily, the results from these split samples were used to evaluate the concentrations of target analytes not included in the ARCADIS project target analyte list. The split sample results also provided a QA check on the representativeness and comparability of the OU2 results.

The split sample results (Table 3-6) were evaluated in a manner similar to the comparison of the field duplicate results by calculating RPD as follows:

$$RPD = \frac{100 * (\text{Primary Result} - \text{Split Sample Result})}{\frac{1}{2} * (\text{Primary Result} + \text{Split Sample Result})}$$

The RPD was calculated for results where an analyte was detected in both split samples. If the analyte was not detected in either one or both of the split samples, the RPD was not calculated. For these cases, the reporting limits or reporting limit and positive results were compared and considered acceptable if no large differences were observed.

The ARCADIS samples were analyzed using EPA Method 8260B. The EPA samples were analyzed using EPA Method 524.2. Despite the different methods, the reporting limits are generally comparable with the exception of 1,2,3-TCP, which was reported by ARCADIS at a reporting limit of 0.005 µg/L, compared to the EPA reporting limit of 0.5 µg/L. Based on the ARCADIS results, 1,2,3-TCP is not present in these wells and the difference in the reporting limits is not a significant issue.

An RPD criterion of 30 percent was used as the criteria to evaluate the pairs of positive split sample results. Out of 183 results, one of the split sample result pairs had an RPD above 30 percent. In this case, the actual results for the target analyte, dichlorodifluoromethane, (0.8 µg/L by EPA Method 524.2 and 0.5 µg/L by EPA Method 8260B) are below the reporting limits; the absolute value of the difference is small compared to the reporting

limits and well within the expected analytical error. Based on the comparison of the split samples, the data were comparable and representative of the media sampled.

TABLE 3-1
Summary of Field and Equipment Blanks Collected
Omega Chemical Superfund Site

Sample ID	Collection Date	Sample Type	Analyte/Analytical Method(s)															
			VOCs (CLP)		VOCs (SIM)	VOCs		SVOCs (CLP)	Emergent Compound			General Chemistry Parameters				Metals	Hexavalent Chromium	Perchlorate
			MC VOA	TVOL	SIMVOL	EPA 524_2	EPA 8260B	MC SVOA	1,2,3-TCP	1,4-Dioxane	NDMA	Alkalinity	Anions	CN	TDS	METALS	EPA 218.6	EPA 314
OC2-00-W-2-3	02-Mar-04	AB	X					X		X	X			X		X	X	X
OC2-00-W-2-16	04-Mar-04	AB	X					X		X		X	X	X	X	X	X	X
OC2-00-W-3-24	15-Jun-04	EB	X						X									
OC2-00-W-2-35	21-Jun-04	AB	X				X		X		X							
OC2-00-W-2-48	23-Jun-04	AB	X						X		X							
OC2-00-W-2-57	13-Sep-04	AB	X						X		X							
OC2-00-W-2-68	15-Sep-04	AB	X						X		X							
OC2-00-W-2-78	30-Nov-04	AB	X						X		X							
OC2-OW1A-W-3-84	01-Dec-04	EB	X						X		X							
OC2-00-W-2-96	06-Dec-04	AB	X						X		X							
OC2-00-W-2-111	09-Dec-04	AB	X						X		X							
OC2-00-W-2-115	28-Feb-05	AB	X						X									
OC2-00-W-2-132	03-Mar-05	AB	X						X									
OC2-MW4A-W-2-136	30-Aug-05	AB	X						X		X							
OC2-MW11-W-2-154	02-Sep-05	AB	X						X		X							
OC2-MW7-W-4-156	06-Mar-06	TB				X			X									
OC2-MW8D-W-2-162	07-Mar-06	AB				X			X									
OC2-MW8D-W-4-160	07-Mar-06	TB				X			X									
OC2-MW9B-W-4-170	08-Mar-06	TB				X			X									
OC2-MW11-W-2-178	09-Mar-06	AB				X			X									
OC2-MW11-W-4-175	09-Mar-06	TB				X			X									
OC2-MW16C-W-3-186	13-Mar-06	EB				X			X									
OC2-MW17B-W-4-182	13-Mar-06	TB				X			X									
OC2-MW16C-W-4-187	14-Mar-06	TB				X			X									
OC2-MW18A-W-2-191	14-Mar-06	AB				X			X									
OC2-MW13B-W-3-202	15-Mar-06	EB				X			X									
OC2-MW15-W-2-200	15-Mar-06	AB				X			X									
OC2-MW23D-W-4-197	15-Mar-06	TB				X			X									
OC2-MW18C-W-2-208	28-Aug-06	AB				X			X									
OC2-TB1-W-4-207	28-Aug-06	TB				X			X									
OC2-TB2-W-4-213	29-Aug-06	TB				X			X									
OC2-MW8D-W-2-221	30-Aug-06	AB				X			X									
OC2-TB3-W-4-220	30-Aug-06	TB				X			X									
OC2-TB4-W-4-227	31-Aug-06	TB				X			X									
OC2-TB5-W-4-233	01-Sep-06	TB				X			X									
OC2-MW17C-W-2-241	05-Sep-06	AB				X			X									
OC2-TB6-W-4-240	05-Sep-06	TB				X			X									
OC2-TB7-W-4-245	07-Sep-06	TB				X			X									
OC2-MW1A-W-2-257	08-Sep-06	AB				X			X									
OC2-TB8-W-4-252	08-Sep-06	TB				X			X									
OC2-TB9-W-4-258	11-Sep-06	TB				X			X									
OC2-EB-W-3-282	10-Jan-07	EB		X	X					X								

TABLE 3-1
Summary of Field and Equipment Blanks Collected
Omega Chemical Superfund Site

Sample ID	Collection Date	Sample Type	Analyte/Analytical Method(s)															
			VOCs (CLP)		VOCs (SIM)	VOCs		SVOCs (CLP)	Emergent Compound			General Chemistry Parameters				Metals	Hexavalent Chromium	Perchlorate
			MC VOA	TVOL	SIMVOL	EPA 524_2	EPA 8260B	MC SVOA	1,2,3-TCP	1,4-Dioxane	NDMA	Alkalinity	Anions	CN	TDS	METALS	EPA 218.6	EPA 314
OC2-HPRA4-W-2-283	10-Jan-07	AB		X	X					X								
OC2-HP285B-W-3-327	23-Jan-07	EB		X	X					X								
OC2-HPF5B-W-3-336	26-Jan-07	EB		X	X					X								
OC2-HP272B-W-2-341	12-Feb-07	AB		X	X					X								
OC2-HP296A-W-3-349	14-Feb-07	EB		X	X					X								
OC2-HPA6A-W-4-351	15-Feb-07	TB		X	X					X								
OC2-HPA8A-W-2-355	19-Feb-07	AB		X	X					X								
OC2-HPF6A-W-3-361	21-Feb-07	EB		X	X					X								
OC2-HPW8B-W-2-366	22-Feb-07	AB		X	X					X								
OC2-AB1-W-2-457	26-Feb-07	AB		X	X					X								
OC2-AB2-W-2-465	27-Feb-07	AB		X	X					X								
OC2-AB3-W-2-472	28-Feb-07	AB		X	X					X								
OC2-AB4-W-2-478	01-Mar-07	AB		X	X					X								
OC2-AB5-W-2-484	02-Mar-07	AB		X	X					X								
OC2-AB6-W-2-491	05-Mar-07	AB		X	X					X								
OC2-HPW3B-W-2-381	05-Mar-07	AB		X	X					X								
OC2-AB7-W-2-497	06-Mar-07	AB		X	X					X								
OC2-AB8-W-2-506	07-Mar-07	AB		X	X					X								
OC2-HPW6A-W-3-385	07-Mar-07	EB		X	X					X								
OC2-HPW6B-W-4-386	08-Mar-07	TB		X	X					X								
OC2-HPW1A-W-3-393	12-Mar-07	EB		X	X					X							X	
OC2-HP278A-W-4-401	13-Mar-07	TB		X	X					X								
OC2-HP2911A-W-2-407	14-Mar-07	AB		X	X					X								
OC2-HPA13A-W-3-429	21-Mar-07	EB		X	X					X								
OC2-HPA15A-W-2-435	22-Mar-07	AB		X	X					X								
OC2-HP2917A-W-3-440	09-Apr-07	EB		X	X					X								
OC2-HP2923A-W-2-512	11-Apr-07	AB		X	X					X								
OC2-HP2923A-W-3-511	11-Apr-07	EB		X	X					X								
OC2-HPF1B-W-3-523	02-May-07	EB		X	X					X								
OC2-HP2933A-W-3-533	04-May-07	EB		X	X					X								
OC2-HP2938A-W-3-537	07-May-07	EB		X	X					X								
OC2-HP2940A-W-3-544	09-May-07	EB		X	X					X								
OC2-AB1-W-2-556	30-May-07	AB				X			X									
OC2-EB1-W-3-559	01-Jun-07	EB				X			X									
OC2-AB1-W-2-X	09-Jul-07	AB		X	X					X								
OC2-AB2-W-2-X	10-Jul-07	AB		X	X					X								
OC2-AB3-W-2-X	11-Jul-07	AB		X	X					X								
OC2-AB4-W-2-X	12-Jul-07	AB		X	X					X								
OC2-AB5-W-2-X	13-Jul-07	AB		X	X					X								
OC2-AB6-W-2-X	16-Jul-07	AB		X	X					X								
OC2-AB7-W-2-X	17-Jul-07	AB		X	X					X								
OC2-AB8-W-2-X	18-Jul-07	AB		X	X					X								

TABLE 3-1
Summary of Field and Equipment Blanks Collected
Omega Chemical Superfund Site

			Analyte/Analytical Method(s)															
			VOCs (CLP)		VOCs (SIM)	VOCs		SVOCs (CLP)	Emergent Compound			General Chemistry Parameters				Metals	Hexavalent Chromium	Perchlorate
Sample ID	Collection Date	Sample Type	MC VOA	TVOL	SIMVOL	EPA 524_2	EPA 8260B	MC SVOA	1,2,3-TCP	1,4-Dioxane	NDMA	Alkalinity	Anions	CN	TDS	METALS	EPA 218.6	EPA 314
OC2-AB9-W-2-X	19-Jul-07	AB		X	X					X								
OC2-AB10-W-2-X	20-Jul-07	AB		X	X					X								
OC2-AB11-W-2-X	23-Jul-07	AB		X	X					X								
OC2-AB12-W-2-X	24-Jul-07	AB		X	X					X								
OC2-AB13-W-2-X	25-Jul-07	AB		X	X					X								
OC2-AB14-W-2-X	26-Jul-07	AB		X	X					X								

AB - ambient blank
EB - equipment blank
FB - field blank
TB - trip blank
CLP - Contract Laboratory Program
VOCs - volatile organic compounds
SVOCs - semivolatile organic compounds

NDMA - N-nitrosodimethylamine
1,2,3-TCP - 1,2,3-Trichloropropane
CN Cyanide
TDS Total Dissolved Solids

Table 3-2
Summary of Field Duplicate Outliers
Omega Chemical Superfund Site

Event	Sample Date	Location ID	Analyte Name	Primary Result	Field Duplicate Result	RPD
2004 QTR1						
	03/03/04	MW6	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	2 J	1.4 J	35
	03/03/04	MW6	Total Organic Carbon	2.7	3.9	36
2004 QTR2						
	06/17/04	OW3A	1,4-Dioxane (p-dioxane)	1.2	0.7 J	53
	06/17/04	OW3A	Bromide	0.2	0.26	26
	06/21/04	MW4A	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	280	490	55
	06/21/04	MW4A	bis(2-Ethylhexyl)phthalate	11	3.9 J	95
	06/21/04	MW4A	Total Organic Carbon	17	11	43
	06/21/04	MW4A	Trichlorofluoromethane (Freon 11)	120	200	50
	06/23/04	MW1A	bis(2-Ethylhexyl)phthalate	9.6	42	126
	06/23/04	MW1A	Chloromethane	6.1 J	11 J	57
	06/23/04	MW1A	Methylene chloride	0.62 J	1.9 J	102
	06/23/04	MW1A	Thallium	12.4 J	7.3 J	52
	06/23/04	MW1A	Toluene	1.3 J	2.2 J	51
	06/23/04	MW1A	Trichlorofluoromethane (Freon 11)	33	48	37
2004 QTR3						
	09/13/04	MW4B	1,2,3-Trichloropropane	0.0028 J	0.0044 J	44
	09/13/04	MW4B	Methyl tert-butyl ether	9.2 J	6.6	33
	09/16/04	MW7	1,2,3-Trichloropropane	0.0069	0.0044	44
	09/16/04	MW7	bis(2-Ethylhexyl)phthalate	32 J	17 J	61
	09/16/04	MW7	N-Nitrosodimethylamine	0.0066	0.0027	84
	09/16/04	MW7	Total Organic Carbon	4.7	7.2	42
2004 QTR4						
	12/02/04	OW5	Chromium VI	4.6	7.6	49
	12/02/04	OW5	Lead	0.08 J	0.05 J	46
	12/02/04	OW5	N-Nitrosodimethylamine	0.0046 J	0.002 J	79
	12/06/04	MW4B	1,2-Dibromo-3-chloropropane	5 R	2 R	86
	12/06/04	MW4B	Chemical oxygen demand	5.8 J	8.3 J	35
	12/06/04	MW4B	Zinc	0.65 J	1.7 J	89
	12/07/04	MW7	bis(2-Ethylhexyl)phthalate	4.6 J	1.3 J	112
2005 QTR1						
	02/28/05	MW4A	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	450	820	58
	02/28/05	MW4A	1,1-Dichloroethene	460	780	52
	02/28/05	MW4A	Chloroform	34	51	40
	02/28/05	MW4A	Tetrachloroethene	400 J	620	43
	02/28/05	MW4A	trans-1,2-Dichloroethene	0.41 J	0.28 J	38
	02/28/05	MW4A	Trichloroethene	130	190	38
	02/28/05	MW4A	Trichlorofluoromethane (Freon 11)	190	350	59
2005 QTR3						
	08/30/05	MW6	1,1-Dichloroethene	11	8	32
	08/30/05	MW6	Methylene chloride	1.1	3.7	108
2006 QTR1						
	03/09/06	MW11	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	0.3 J	0.2 J	40
	03/15/06	MW15	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	1400	910	42
	03/15/06	MW15	1,1-Dichloroethene	2000	1000	67
	03/15/06	MW15	Chloroform	440	210	71

Table 3-2
Summary of Field Duplicate Outliers
Omega Chemical Superfund Site

Event	Sample Date	Location ID	Analyte Name	Primary Result	Field Duplicate Result	RPD
2006 QTR1						
	03/15/06	MW15	Dichlorodifluoromethane (Freon 12)	4.7	2.7	54
	03/15/06	MW15	N-Nitrosodimethylamine	0.003	0.0048	46
	03/15/06	MW15	Tetrachloroethene	1900	840	77
	03/15/06	MW15	Trichloroethene	540	260	70
	03/15/06	MW15	Trichlorofluoromethane (Freon 11)	670	340	65
2006 QTR3						
	08/29/06	MW4B	Carbon tetrachloride	0.2 J	0.3 J	40
	09/01/06	MW20A	1,1-Dichloroethane	2.3	3.4	39
	09/01/06	MW20A	1,1-Dichloroethene	15	21	33
	09/01/06	MW20A	Chloroform	0.5	0.8	46
	09/01/06	MW20A	cis-1,2-Dichloroethene	1.2	1.8	40
	09/01/06	MW20A	Trichlorofluoromethane (Freon 11)	4.9	7.1	37
	09/07/06	MW10	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	77	25	102
	09/07/06	MW10	1,1-Dichloroethene	43	23	61
	09/07/06	MW10	1,2-Dichloroethane	0.2 J	0.3 J	40
	09/07/06	MW10	Tetrachloroethene	82	190	79
	09/07/06	MW10	Trichloroethene	110	62	56
	09/07/06	MW10	Trichlorofluoromethane (Freon 11)	34	16	72
	09/11/06	MW23C	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	790	350	77
	09/11/06	MW23C	1,1,2-Trichloroethane	0.2 J	0.3 J	40
	09/11/06	MW23C	1,1-Dichloroethene	600	270	76
	09/11/06	MW23C	Benzene	0.3 J	0.2 J	40
	09/11/06	MW23C	cis-1,2-Dichloroethene	24	16	40
	09/11/06	MW23C	Dichlorodifluoromethane (Freon 12)	1	0.5 J	67
	09/11/06	MW23C	Perchlorate	3.6	2	57
	09/11/06	MW23C	Tetrachloroethene	500	210	82
	09/11/06	MW23C	trans-1,2-Dichloroethene	1.5	0.9	50
	09/11/06	MW23C	Trichloroethene	610	230	90
	09/11/06	MW23C	Trichlorofluoromethane (Freon 11)	250	120	70
2007 QTR1HP						
	01/23/07	HP28-5A (90')	1,1-Dichloroethene	1.5	0.95	45
	01/23/07	HP28-5A (90')	Carbon disulfide	0.15 J	0.26 J	54
	01/23/07	HP28-5A (90')	Tetrachloroethene	0.18 J	0.12 J	40
	02/13/07	HP29-2A (97')	1,1-Dichloroethene	4.2 J	1.5 J	95
	02/13/07	HP29-2A (97')	1,4-Dioxane (p-dioxane)	5.6 J	4.1 J	31
	02/13/07	HP29-2A (97')	Chloroform	0.52 J	0.78 J	40
	02/13/07	HP29-2A (97')	cis-1,2-Dichloroethene	24 J	12 J	67
	02/13/07	HP29-2A (97')	Methyl tert-butyl ether	1.4 J	0.86 J	48
	02/13/07	HP29-2A (97')	trans-1,2-Dichloroethene	6.2 J	2.8 J	76
	02/13/07	HP29-2A (97')	Trichloroethene	8.9 J	4.2 J	72
	02/13/07	HP29-2A (97')	Trichlorofluoromethane (Freon 11)	0.22 J	1.1 J	133
	02/13/07	HP29-2A (97')	Vinyl chloride	2.3 J	0.86 J	91
	03/09/07	HPW-5B (50')	1,1-Dichloroethene	6	2.5	82
	03/09/07	HPW-5B (50')	Aluminum	293	1670	140
	03/09/07	HPW-5B (50')	Carbon disulfide	0.15 J	0.28 J	60
	03/09/07	HPW-5B (50')	Carbon tetrachloride	0.42 J	0.2 J	71
	03/09/07	HPW-5B (50')	Chloroform	7.6	5.1	39

Table 3-2
Summary of Field Duplicate Outliers
Omega Chemical Superfund Site

Event	Sample Date	Location ID	Analyte Name	Primary Result	Field Duplicate Result	RPD
2007 QTR1HP						
	03/09/07	HPW-5B (50')	Chromium	4.4	10.1	79
	03/09/07	HPW-5B (50')	Cobalt	2.4	4.5	61
	03/09/07	HPW-5B (50')	Copper	0.89 J	8.2	161
	03/09/07	HPW-5B (50')	Iron	51.4 J	1230	184
	03/09/07	HPW-5B (50')	Selenium	3 J	2.1 J	35
	03/09/07	HPW-5B (50')	Tetrachloroethene	95	27	111
	03/09/07	HPW-5B (50')	Trichloroethene	3 J	1.7	55
	03/09/07	HPW-5B (50')	Vanadium	1.6	10.5	147
	03/09/07	HPW-5B (50')	Zinc	7	16.3	80
	03/13/07	HP27-7A (87')	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	1.2	0.59 J	68
	03/13/07	HP27-7A (87')	trans-1,2-Dichloroethene	0.93 J	0.53 J	55
	03/13/07	HP27-7A (87')	Vinyl chloride	0.46 J	0.3 J	42
2007 QTR3						
	07/09/07	MW24A	Dichlorodifluoromethane (Freon 12)	1.8 J	2.7	40
	07/09/07	MW24A	Tetrachloroethene	590 J	320	59
	07/09/07	MW24A	Total Organic Carbon	0.54	0.81	40
	07/12/07	MW27B	1,1,2-Trichloroethane	0.43 J	10	184
	07/12/07	MW27B	1,1-Dichloroethene	360 J	150	82
	07/12/07	MW27B	Di-n-butyl phthalate	4.3 J	1.2 J	113
	07/12/07	MW27B	Tetrachloroethene	220	120	59
	07/12/07	MW27B	Total kjeldahl nitrogen	0.15 J	0.23 J	42
	07/12/07	MW27B	Trichloroethene	220	140	44
	07/12/07	MW27B	Zinc	2.6 J+	3.7 J+	35
	07/17/07	MW12	1,1-Dichloroethene	4.2	18	124
	07/17/07	MW12	Chloroform	0.19 J	0.41 J	73
	07/17/07	MW12	Chromium VI	0.99	1.7	53
	07/17/07	MW12	Tetrachloroethene	1.1	22 J	181
	07/17/07	MW12	Trichloroethene	6.6	160 J	184

Notes

RPD - Relative Percent Difference = $\{ (\text{Primary Sample} - \text{Field Duplicate}) / (\text{Primary Sample} + \text{Field Duplicate}) / 2 \} \times 100$
RPD is calculated and shown only when both the primary and Field Duplicate samples are detected above the Reporting Limit
Field duplicate RPD goal is 50% for Perchlorate, 25% for Anions, Total dissolved solids, Biological oxygen demand, and Total kjeldahl nitrogen, and 30% for all others .

µg/L - micrograms per liter

mg/L - milligrams per liter

U - Not detected at or above the reporting limit.

UJ - Not detected at or above the reporting limit. The reporting limit is an estimate.

J - Estimated value.

J+ estimated result with high bias.

Table 3-3
Summary of Data Review and Validation Performed
Omega Chemical Superfund Site

Category	Percentage of Tier 1 Reviewed Results	Percentage of Tier 2 Reviewed Results	Percentage of Tier 3 Reviewed Results	Percentage of Unvalidated Results
VOCs (SIM)	54%	29%	18%	0%
VOCs (EPA 524.2/SW8260B)	86%	0%	13%	0%
VOCs (CLP)	65%	16%	19%	0%
SVOCs (SIM)	0%	100%	0%	0%
SVOCs (CLP)	65%	19%	16%	0%
Perchlorate	95%	0%	5%	0%
Metals	67%	0%	33%	0%
Hexavalent Chromium	8%	57%	15%	20%
General Chemistry Parameters	95%	0%	3%	2%
Emergent Compounds (1)	43%	27%	15%	15%

Notes:

(1) Emergent compounds include 1,4 Dioxane, 1,2,3-Trichloropropane and N-Nitrosodimethylamine

TABLE 3-4
Summary of Reason Codes
Omega Chemical Superfund Site

Basis	Reason Code	Reason Code Definition	Description
Flags Applied Based on Analyte Contamination	A1	LCS Recovery	The recovery from the laboratory control sample did not meet acceptance criteria. High recoveries result in qualification of positive results with a high bias; recoveries below the lower recoveries result in qualification of positive results with a high bias; recoveries below the lower control limit result in qualification of quantitation limit.
	A2	MS/MSD Recovery	The recovery from the matrix spike and/or matrix spike duplicate did not meet acceptance criteria. High recoveries result in qualification of positive results with a high bias; recoveries below the lower control limit result in qualification of both positive results and quantitation limits.
	A3	Surrogate Recovery	The surrogate recovery did not meet the acceptance criteria; the results and quantitation limits for associated analytes are qualified as estimated, with a low bias. High surrogate recoveries result in qualification of positive results with a high bias.
	B1	Laboratory Blank Contamination	The analyte was detected in the sample at a concentration less than 5 times (10 times for common laboratory contaminants) the amount found in the associated laboratory blank. The results are raised to the reporting limit or qualified as not detected at the amount reported (if above the reporting limit)
	B2	Equipment Blank Contamination	The analyte was detected in the sample at a concentration less than 5 times (10 times for common laboratory contaminants) the amount found in the associated equipment blank. The results are raised to the reporting limit or qualified as not detected at the amount reported (if above the reporting limit)

TABLE 3-4
Summary of Reason Codes
Omega Chemical Superfund Site

Basis	Reason Code	Reason Code Definition	Description
Qualifications Affecting Accuracy	B3	Field Blank Contamination	The analyte was detected in the sample at a concentration less than 5 times (10 times for common laboratory contaminants) the amount found in the associated field blank. The results are raised to the reporting limit or qualified as not detected at the amount reported (if above the reporting limit)
	B4	Trip Blank Contamination	The analyte was detected in the sample at a concentration less than 5 times (10 times for common laboratory contaminants) the amount found in the associated trip blank. The results are raised to the reporting limit or qualified as not detected at the amount reported (if above the reporting limit)
	B5	Initial Calibration Blank Contamination	The analyte was detected in the initial calibration blank. For associated samples, detected results less than the reporting limit are qualified as not detected at the reporting limit.
	B6	Continuing Calibration Blank Contamination	The analyte was detected in the continuing calibration blank. For associated samples, detected sample results less than the reporting limit are qualified as not detected at the reporting limit.
	B7	Source Blank Contamination	The analyte was detected in the source water used to prepare equipment and field blanks. The information is used to evaluate the suitability of the water as a final decontamination rinse.
	B8	Storage Blank Contamination	The analyte was detected in the sample at a concentration less than 5 times (10 times for common laboratory contaminants) the amount found in the storage blank, used in the laboratory to evaluate potential cross contamination. The results are raised to the reporting limit or qualified as not detected at the amount reported (if above the reporting limit)
	C1	Initial Calibration Relative Standard Deviation	ICAL%RSD The percent relative standard deviation for the initial calibration response factor did not meet the linearity acceptance criterion and quantitation may be more imprecise and inaccurate than expected.

TABLE 3-4
Summary of Reason Codes
Omega Chemical Superfund Site

Basis	Reason Code	Reason Code Definition	Description
	C2	Initial Calibration Response Factor	The average response factor from the initial calibration did not meet the acceptance criterion and analytical sensitivity may be less than expected.
	C3	Calibration Percent Difference	The percent difference between the response factor in the continuing calibration standard and the average response factor from the initial calibration standard exceeded the acceptance criteria. Analytical precision may be larger than expected.
	C4	Continuing Calibration Percent Recovery	The recovery of the analyte in the continuing calibration verification standard did not meet the method acceptance criteria. Positive results are qualified as estimated if the standard recovery is high; both positive results and quantitation limits are qualified as estimated if the standard recovery is low.
	C5	Continuing Calibration Response Factor	The response factor in the continuing calibration did not meet the acceptance criterion and analytical sensitivity may be less than expected.
	C6	Initial Calibration Verification	An initial calibration verification standard is analyzed to test the accuracy of the initial calibration using a second source standard. When analyte recoveries do not meet the acceptance criteria, the initial calibration may be inaccurate.
	Carryover Contamination	Carryover Contamination	The result is qualified as estimated because the previous sample in the run had a high concentration of the target analyte; there is the potential for a high bias in the qualified result.
	D2	MS/MSD Duplicate Relative Percent Difference	The precision between matrix spike and matrix spike duplicate samples did not meet acceptance criteria, and higher than expected variability may be present.
	D3	Sample Duplicate Relative Percent Difference	The precision between laboratory duplicates did not meet acceptance criteria, and higher than expected variability may be present.

TABLE 3-4
Summary of Reason Codes
Omega Chemical Superfund Site

Basis	Reason Code	Reason Code Definition	Description
Qualifications Affecting both Accuracy and Precision	D4	Field Duplicate Relative Percent Difference	The precision between field duplicate samples did not meet acceptance criteria, and higher than expected variability may be present. (no qualification is applied based on field duplicates only)
	Q1	Result Over Calibration Range	Reported result exceeded the concentration of the highest concentration standard. The result is qualified as estimated and is considered to represent the minimum sample concentration. The true concentration may be higher than reported.
	Q2	Failed Spectral Match	The GC/MS spectral match criteria were not met. As a result, the analyte is reported as not
	Q4	Holding Time Exceeded	The holding time was exceeded. Positive results and quantitation limits are qualified as estimated; positive results may be biased low due to analyte losses during storage.
	Q6	Quantitation Limit Standard Recovery	The quantitation limit standard did not meet the control limit (EPA Region 9 Laboratory specific QC). The ability of the analytical system to meet the quantitation may be impaired.
	Q7	Serial Dilution Recovery	The agreement between diluted and undiluted analyses did not meet acceptance criteria and a matrix effect may be present.
	Q8	Interference	Interferences from other analytes may affect quantitation. Reporting limit may be raised.
	Tr	Result Below Reporting Limit	The result is above the MDL but below the quantitation limit; there is some associated uncertainty in results as the limit of detection is approached.

Table 3-5
Summary of Number of Qualified Results by Event and Reason Codes
Omega Chemical Superfund Site

				Tier 1/ Tier 2		Tier 3	
Event Analysis		Reason Code and Description		Number		Number	
				J's	R's	J's	R's
2004_QTR1							
BOD: EPA 405.1	A1	LCS Recovery		3	0	0	0
BOD: EPA 405.1	A2	MS/MSD Recovery		2	0	0	0
CN	A2	MS/MSD Recovery		1	0	0	0
METALS	A2	MS/MSD Recovery		1	0	0	0
TOC	A2	MS/MSD Recovery		1	0	0	0
SVOCs: MC SVOA	A3	Surrogate Recovery		8	0	15	0
VOCs: MC VOA	A3	Surrogate Recovery		85	4	0	0
SVOCs: MC SVOA	C1	Initial Calibration Relative Standard Deviation		0	0	1	0
VOCs: MC VOA	C1	Initial Calibration Relative Standard Deviation		15	0	2	0
VOCs: MC VOA	C2	Initial Calibration Response Factor		1	0	5	0
SVOCs: MC SVOA	C3	Calibration Percent Difference		44	0	2	0
VOCs: MC VOA	C3	Calibration Percent Difference		20	0	2	0
VOCs: MC VOA	C5	Continuing Calibration Response Factor		1	0	5	0
VOCs: MC VOA	D2	MS/MSD Duplicate Relative Percent Difference		16	0	0	0
1,4-Dioxane	Q4	Holding Time Exceeded		7	0	0	0
Anions: EPA 300	Q4	Holding Time Exceeded		9	0	0	0
BOD: EPA 405.1	Q4	Holding Time Exceeded		7	0	0	0
VOCs: MC VOA	Q5	Internal Standard		0	7	0	0
2004_QTR2							
BOD: EPA 405.1	A1	LCS Recovery		9	0	0	0
METALS	A2	MS/MSD Recovery		38	0	0	0
TKN: EPA 351.2	A2	MS/MSD Recovery		1	0	0	0
1,4-Dioxane	A3	Surrogate Recovery		1	0	0	0
SVOCs: MC SVOA	A3	Surrogate Recovery		17	0	0	0
VOCs: MC VOA	A3	Surrogate Recovery		16	0	0	0
SVOCs: MC SVOA	B1	Laboratory Blank Contamination		30	0	0	0
VOCs: MC VOA	B1	Laboratory Blank Contamination		22	0	0	0
METALS	B5	Initial Calibration Blank Contamination		8	0	0	0
METALS	B6	Continuing Calibration Blank Contamination		20	0	0	0
SVOCs: MC SVOA	C1	Initial Calibration Relative Standard Deviation		1	0	0	0
SVOCs: MC SVOA	C2	Initial Calibration Response Factor		0	29	0	0
METALS	C3	Calibration Percent Difference		22	1	0	0
SVOCs: MC SVOA	C3	Calibration Percent Difference		50	29	0	0
VOCs: MC VOA	C3	Calibration Percent Difference		4	0	0	0
SVOCs: MC SVOA	C5	Continuing Calibration Response Factor		0	29	0	0
METALS	D3	Sample Duplicate Relative Percent Difference		13	0	0	0
METALS	D4	Field Duplicate Relative Percent Difference		11	0	0	0
VOCs: MC VOA	Q1	Result Over Calibration Range		4	0	0	0
METALS	Q10	Quality Control Analysis Not Performed		0	0	78	12
BOD: EPA 405.1	Q4	Holding Time Exceeded		3	0	0	0

Table 3-5
Summary of Number of Qualified Results by Event and Reason Codes
Omega Chemical Superfund Site

Event Analysis Reason Code and Description			Tier 1/ Tier 2		Tier 3	
			Number		Number	
			J's	R's	J's	R's
2004_QTR2						
1,4-Dioxane	Q5	Internal Standard	4	0	0	0
METALS	Q5	Internal Standard	120	60	0	12
METALS	Q7	Serial Dilution	0	0	15	0
Anions: EPA 300	Q8	Interference (Quantitation Limit Raised	0	0	0	0
2004_QTR3						
BOD: EPA 405.1	A1	LCS Recovery	9	0	0	0
TOC: EPA 415.1	A2	MS/MSD Recovery	1	0	0	0
SVOCs: MC SVOA	A3	Surrogate Recovery	0	0	54	0
VOCs: MC VOA	A3	Surrogate Recovery	2	0	12	0
SVOCs: MC SVOA	B1	Laboratory Blank Contamination	0	0	10	0
VOCs: MC VOA	B1	Laboratory Blank Contamination	0	0	27	0
VOCs: MC VOA	B3	Fleld Blank Contamination	0	0	17	0
METALS	B5	Initial Calibration Blank Contamination	19	0	0	0
METALS	B6	Continuing Calibration Blank Contamination	24	0	0	0
SVOCs: MC SVOA	C1	Initial Calibration Relative Standard Deviation	0	0	42	0
VOCs: MC VOA	C1	Initial Calibration Relative Standard Deviation	0	0	27	0
SVOCs: MC SVOA	C2	Initial Calibration Response Factor	0	0	14	0
VOCs: MC VOA	C2	Initial Calibration Response Factor	0	0	66	0
CR6: EPA 218.6	C3	Calibration Percent Difference	4	0	0	0
METALS	C3	Calibration Percent Difference	54	4	0	0
SVOCs: MC SVOA	C3	Calibration Percent Difference	0	0	14	0
VOCs: MC VOA	C3	Calibration Percent Difference	0	0	53	0
SVOCs: MC SVOA	C5	Continuing Calibration Response Factor	0	0	14	0
VOCs: MC VOA	C5	Continuing Calibration Response Factor	0	0	66	0
CR6: EPA 218.6	C6	Initial Calibration Verification	4	0	0	0
VOCs: MC VOA	Q1	Result Over Calibration Range	0	0	5	0
SVOCs: MC SVOA	Q2	Failed Spectral Match	0	0	2	0
BOD: EPA 405.1	Q4	Holding Time Exceeded	7	0	0	0
VOCs: MC VOA	Q4	Holding Time Exceeded	0	0	47	0
METALS	Q5	Internal Standard	8	15	0	0
Anions: EPA 300	Q8	Interference (Quantitation Limit Raised	0	0	0	0
2004_QTR4						
1,4-Dioxane	A3	Surrogate Recovery	2	0	0	0
NDMA: EPA 162.5	A3	Surrogate Recovery	16	0	4	0
SVOCs: MC SVOA	A3	Surrogate Recovery	22	0	0	0
VOCs: MC VOA	A3	Surrogate Recovery	19	0	0	0
BOD: EPA 405.1	A4	Standard Reference Material Recovery	1	0	0	0
NDMA: EPA 162.5	B1	Laboratory Blank Contamination	1	0	0	0
SVOCs: MC SVOA	B1	Laboratory Blank Contamination	29	0	0	0
VOCs: MC VOA	B1	Laboratory Blank Contamination	6	0	0	0

Table 3-5
Summary of Number of Qualified Results by Event and Reason Codes
Omega Chemical Superfund Site

Event AnalysisReason Code and Description			Tier 1/ Tier 2		Tier 3	
			Number		Number	
			J's	R's	J's	R's
2004_QTR4						
METALS	B5	Initial Calibration Blank Contamination	7	0	1	0
VOCs: MC VOA	B5	Initial Calibration Blank Contamination	14	0	0	0
METALS	B6	Continuing Calibration Blank Contamination	21	0	3	0
SVOCs: MC SVOA	C1	Initial Calibration Relative Standard Deviation	90	25	0	0
VOCs: MC VOA	C2	Initial Calibration Response Factor	0	30	0	0
SVOCs: MC SVOA	C3	Calibration Percent Difference	111	25	0	0
VOCs: MC VOA	C3	Calibration Percent Difference	23	0	0	0
SVOCs: MC SVOA	C5	Continuing Calibration Response Factor	1	25	0	0
BOD: EPA 405.1	Q4	Holding Time Exceeded	4	0	0	0
NDMA: EPA 162.5	Q4	Holding Time Exceeded	5	0	0	0
NDMA: EPA 162.5	Q5	Internal Standard	16	0	4	0
SVOCs: MC SVOA	Q5	Internal Standard	19	0	0	0
VOCs: MC VOA	Q5	Internal Standard	13	0	0	0
2005_QTR1						
NDMA: EPA 162.5	A3	Surrogate Recovery	0	0	0	0
VOCs: MC VOA	A3	Surrogate Recovery	0	0	20	0
VOCs: MC VOA	B1	Laboratory Blank Contamination	0	0	23	0
VOCs: MC VOA	B3	Fleld Blank Contamination	0	0	23	0
VOCs: MC VOA	C3	Calibration Percent Difference	0	0	40	0
VOCs: MC VOA	C5	Continuing Calibration Response Factor	0	0	9	0
VOCs: MC VOA	D2	MS/MSD Duplicate Relative Percent Difference	0	0	1	0
NDMA: EPA 162.5	Q5	Internal Standard	0	0	0	0
2005_QTR3						
NDMA: EPA 162.5	A3	Surrogate Recovery	0	0	0	0
VOCs: MC VOA	A3	Surrogate Recovery	38	0	5	0
VOCs: MC VOA	B1	Laboratory Blank Contamination	9	0	6	0
VOCs: MC VOA	B3	Fleld Blank Contamination	0	0	6	0
VOCs: MC VOA	B5	Initial Calibration Blank Contamination	5	0	0	0
VOCs: MC VOA	B7	Source Blank Contamination	0	0	6	0
VOCs: MC VOA	C1	Initial Calibration Relative Standard Deviation	13	1	2	0
VOCs: MC VOA	C3	Calibration Percent Difference	6	1	0	0
VOCs: MC VOA	Q4	Holding Time Exceeded	0	1	0	0
NDMA: EPA 162.5	Q5	Internal Standard	0	0	0	0
2006_QTR1						
VOCs: EPA 524.2	A2	MS/MSD Recovery	3	0	0	0
VOCs: EPA 524.2	B2	Equipment Blank Contamination	0	0	3	0
VOCs: EPA 524.2	B4	Trip Blank Contamination	0	0	3	0
VOCs: EPA 524.2	C1	Initial Calibration Relative Standard Deviation	44	0	1	0
VOCs: EPA 524.2	C3	Calibration Percent Difference	18	0	0	0
VOCs: EPA 524.2	C4	Continuing Calibration Percent Recovery	1	0	0	0

Table 3-5
Summary of Number of Qualified Results by Event and Reason Codes
Omega Chemical Superfund Site

			Tier 1/ Tier 2		Tier 3		
Event Analysis	Reason Code and Description		Number		Number		
			J's	R's	J's	R's	
2006_QTR1							
VOCs: EPA 524.2	D2	MS/MSD Duplicate Relative Percent Difference	1	0	0	0	
VOCs: EPA 524.2	Q6	Quantitation Limit Standard Verification	9	0	0	0	
2006_QTR3							
VOCs: EPA 524.2	A1	LCS Recovery	2	0	8	0	
CR6: EPA 218.6	A2	MS/MSD Recovery	1	0	0	0	
VOCs: EPA 524.2	A2	MS/MSD Recovery	3	0	0	0	
VOCs: EPA 524.2	C1	Initial Calibration Relative Standard Deviation	110	0	26	0	
VOCs: EPA 524.2	C3	Calibration Percent Difference	14	0	9	0	
VOCs: EPA 524.2	D2	MS/MSD Duplicate Relative Percent Difference	1	0	5	0	
NDMA: EPA 162.5	Q4	Holding Time Exceeded	6	0	0	0	
VOCs: EPA 524.2	Q6	Quantitation Limit Standard Verification	35	0	3	0	
2007_QTR1							
VOCs: EPA 524.2	A2	MS/MSD Recovery	1	0	0	0	
VOCs: TVOL	A3	Surrogate Recovery	53	0	0	0	
VOCs: TVOL	B1	Laboratory Blank Contamination	1	0	0	0	
VOCs: EPA 524.2	C1	Initial Calibration Relative Standard Deviation	8	0	0	0	
1,4-Dioxane	C2	Initial Calibration Response Factor	0	0	0	0	
VOCs: SIMVOL	C2	Initial Calibration Response Factor	9	0	6	0	
VOCs: TVOL	C2	Initial Calibration Response Factor	37	0	0	0	
VOCs: EPA 524.2	C3	Calibration Percent Difference	4	0	0	0	
VOCs: TVOL	C3	Calibration Percent Difference	15	0	0	0	
VOCs: TVOL	C5	Continuing Calibration Response Factor	37	0	0	0	
VOCs: TVOL	D2	MS/MSD Duplicate Relative Percent Difference	22	0	0	0	
VOCs: TVOL	Q1	Result Over Calibration Range	2	0	0	0	
VOCs: EPA 524.2	Q6	Quantitation Limit Standard Verification	12	0	0	0	
2007_QTR1HP							
1,4-Dioxane	A3	Surrogate Recovery	16	7	10	0	
VOCs: TVOL	A3	Surrogate Recovery	142	0	20	0	
VOCs: TVOL	B1	Laboratory Blank Contamination	34	0	0	0	
METALS	B2	Equipment Blank Contamination	0	0	9	0	
VOCs: TVOL	B3	Feld Blank Contamination	1	0	0	0	
METALS	B5	Initial Calibration Blank Contamination	3	0	3	0	
METALS	B6	Continuing Calibration Blank Contamination	4	0	6	0	
VOCs: TVOL	B7	Source Blank Contamination	41	0	0	0	
1,4-Dioxane	C2	Initial Calibration Response Factor	26	29	15	3	
VOCs: TVOL	C2	Initial Calibration Response Factor	2	1	51	0	
METALS	C3	Calibration Percent Difference	0	0	1	0	
VOCs: TVOL	C3	Calibration Percent Difference	2	0	0	0	
1,4-Dioxane	C5	Continuing Calibration Response Factor	35	33	15	3	
VOCs: TVOL	C5	Continuing Calibration Response Factor	2	1	51	0	

Table 3-5
Summary of Number of Qualified Results by Event and Reason Codes
Omega Chemical Superfund Site

Event Analysis		Reason Code and Description	Tier 1/ Tier 2		Tier 3	
			Number		Number	
			J's	R's	J's	R's
2007_QTR1HP						
VOCs: TVOL	D2	MS/MSD Duplicate Relative Percent Difference	0	0	0	0
METALS	D3	Sample Duplicate Relative Percent Difference	4	0	0	0
VOCs: TVOL	Q1	Result Over Calibration Range	0	0	2	0
METALS	Q7	Serial Dilution	4	0	9	0
2007_QTR2						
VOCs: EPA 524.2	A2	MS/MSD Recovery	4	0	0	0
VOCs: EPA 524.2	C1	Initial Calibration Relative Standard Deviation	26	0	0	0
VOCs: EPA 524.2	C3	Calibration Percent Difference	1	0	0	0
VOCs: EPA 524.2	Q6	Quantitation Limit Standard Verification	13	0	0	0
2007_QTR2HP						
1,4-Dioxane	A3	Surrogate Recovery	2	3	0	0
VOCs: TVOL	A3	Surrogate Recovery	45	0	0	0
VOCs: TVOL	B1	Laboratory Blank Contamination	7	0	0	0
METALS	B5	Initial Calibration Blank Contamination	1	0	0	0
METALS	B6	Continuing Calibration Blank Contamination	1	0	0	0
VOCs: EPA 524.2	C1	Initial Calibration Relative Standard Deviation	16	0	0	0
1,4-Dioxane	C2	Initial Calibration Response Factor	18	19	0	0
VOCs: EPA 524.2	C2	Initial Calibration Response Factor	4	0	0	0
1,4-Dioxane	C5	Continuing Calibration Response Factor	18	19	0	0
VOCs: TVOL	D2	MS/MSD Duplicate Relative Percent Difference	0	0	0	0
VOCs: EPA 524.2	Q6	Quantitation Limit Standard Verification	9	0	0	0
METALS	Q7	Serial Dilution	8	0	0	0
2007_QTR3						
1,4-Dioxane	A3	Surrogate Recovery	0	0	13	0
SVOCs: CSVOL	A3	Surrogate Recovery	28	3	0	0
VOCs: TVOL	A3	Surrogate Recovery	24	0	10	0
VOCs: TVOL	B1	Laboratory Blank Contamination	74	0	3	0
VOCs: TVOL	B2	Equipment Blank Contamination	0	0	30	0
VOCs: TVOL	B8	Storage Blank Contamination	23	0	0	0
1,4-Dioxane	C2	Initial Calibration Response Factor	0	2	4	0
SVOCs: CSVOL	C2	Initial Calibration Response Factor	22	0	0	0
SVOCs: SIMSVOL	C2	Initial Calibration Response Factor	16	5	0	0
VOCs: TVOL	C2	Initial Calibration Response Factor	0	0	16	0
SVOCs: CSVOL	C3	Calibration Percent Difference	30	0	0	0
SVOCs: SIMSVOL	C3	Calibration Percent Difference	17	0	0	0
1,4-Dioxane	C5	Continuing Calibration Response Factor	0	2	0	0
SVOCs: CSVOL	C5	Continuing Calibration Response Factor	22	0	0	0
SVOCs: SIMSVOL	C5	Continuing Calibration Response Factor	0	5	0	0
VOCs: TVOL	Q1	Result Over Calibration Range	0	0	1	0
1,4-Dioxane	Q5	Internal Standard	0	0	1	0

Table 3-5
Summary of Number of Qualified Results by Event and Reason Codes
Omega Chemical Superfund Site

Event Analysis	Reason Code and Description	Tier 1/ Tier 2 Number		Tier 3 Number	
		J's	R's	J's	R's

Notes.
See Table A1-17 for additiona description of reason codes.

Table 3-6
Summary of Split Samples
Omega Chemical Superfund Site

Location ID	Sample Date	Analyte Name	CH2M Result	ARCADIS Result	RPD, %
MW12	07/06/06	1,1,1,2-Tetrachloroethane	0.5 U	1 U	NC
		1,1,1-Trichloroethane	0.5 U	0.5 U	NC
		1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	NC
		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	0.5 U	1 U	NC
		1,1,2-Trichloroethane	0.5 U	0.5 U	NC
		1,1-Dichloroethane	0.5 U	0.5 U	NC
		1,1-Dichloroethene	9.6	8.1	17
		1,1-Dichloropropene	0.5 U	0.5 U	NC
		1,2,3-Trichlorobenzene	0.5 U	1 U	NC
		1,2,3-Trichloropropane	0.5 U	0.005 U	NC
		1,2,4-Trichlorobenzene	0.5 U	1 U	NC
		1,2,4-Trimethylbenzene	0.5 U	0.5 U	NC
		1,2-Dibromo-3-chloropropane	2 U	1 U	NC
		1,2-Dibromoethane	0.5 U	0.5 U	NC
		1,2-Dichlorobenzene	0.5 U	0.5 U	NC
		1,2-Dichloroethane	0.5 U	0.5 U	NC
		1,2-Dichloropropane	0.5 U	0.5 U	NC
		1,3,5-Trimethylbenzene	0.5 U	1 U	NC
		1,3-Dichlorobenzene	0.5 U	0.5 U	NC
		1,3-Dichloropropane	0.5 U	0.5 U	NC
		1,4-Dichlorobenzene	0.5 U	0.5 U	NC
		1,4-Dioxane (p-dioxane)	0.5 J	1.9 U	117
		2,2-Dichloropropane	0.5 U	1 U	NC
		2-Chlorotoluene	0.5 U	1 U	NC
		4-Chlorotoluene	0.5 U	1 U	NC
		Acetone	4 UJ	10 U	NC
		Benzene	0.5 U	0.5 U	NC
		Bromodichloromethane	0.5 U	0.5 U	NC
		Bromoform	0.5 UJ	0.72	NC
		Bromomethane	0.5 U	0.5 U	NC
		Carbon tetrachloride	0.5 U	0.5 U	NC
		Chlorobenzene	0.5 U	1 U	NC
		Chloroethane	0.5 U	0.5 U	NC
		Chloroform	0.3 J	0.27 J	11
		Chloromethane	0.5 U	1 U	NC
		cis-1,2-Dichloroethene	0.5 U	0.5 U	NC
		cis-1,3-Dichloropropene	0.5 U	0.5 U	NC
		Dibromochloromethane	0.5 U	0.53 J	NC

Table 3-6
Summary of Split Samples
Omega Chemical Superfund Site

Location ID	Sample Date	Analyte Name	CH2M Result	ARCADIS Result	RPD, %
MW12	07/06/06	Dibromomethane	0.5 U	1 U	NC
		Dichlorodifluoromethane (Freon 12)	0.5 UJ	1 U	NC
		Ethylbenzene	0.5 U	0.5 U	NC
		Hexachlorobutadiene	0.5 U	1 U	NC
		Isopropylbenzene	0.5 U	0.5 U	NC
		m,p-Xylenes	1 U	1 U	NC
		Methyl ethyl ketone	4 UJ	5 U	NC
		Methyl tert-butyl ether	2 U	1 U	NC
		Methylene chloride	0.5 U	1 U	NC
		Naphthalene	0.5 U	2 U	NC
		N-butylbenzene	0.5 U	1 U	NC
		n-Propylbenzene	0.5 U	1 U	NC
		o-Xylene	0.5 U	1 U	NC
		sec-Butylbenzene	0.5 U	1 U	NC
		Styrene	0.5 U	0.5 U	NC
		t-Butylbenzene	0.5 U	1 U	NC
		Tetrachloroethene	20	17	16
		Toluene	0.2 J	0.22 J	10
		trans-1,2-Dichloroethene	0.5 U	0.5 U	NC
		trans-1,3-Dichloropropene	0.5 U	0.5 U	NC
		Trichloroethene	96	91	5
		Trichlorofluoromethane (Freon 11)	0.5 U	1 U	NC
		Vinyl chloride	0.5 U	0.5 U	NC
MW13B	07/06/06	1,1,1,2-Tetrachloroethane	0.5 U	1 U	NC
		1,1,1-Trichloroethane	0.5 U	0.5 U	NC
		1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	NC
		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	0.5 U	1 U	NC
		1,1,2-Trichloroethane	0.5 U	0.5 U	NC
		1,1-Dichloroethane	0.5 U	0.5 U	NC
		1,1-Dichloroethene	0.5 U	0.5 U	NC
		1,1-Dichloropropene	0.5 U	0.5 U	NC
		1,2,3-Trichlorobenzene	0.5 U	1 U	NC
		1,2,3-Trichloropropane	0.5 U	0.005 U	NC
		1,2,4-Trichlorobenzene	0.5 U	1 U	NC
		1,2,4-Trimethylbenzene	0.5 U	0.5 U	NC
		1,2-Dibromo-3-chloropropane	2 U	1 U	NC
		1,2-Dibromoethane	0.5 U	0.5 U	NC
		1,2-Dichlorobenzene	0.5 U	0.5 U	NC

Table 3-6
Summary of Split Samples
Omega Chemical Superfund Site

Location ID	Sample Date	Analyte Name	CH2M Result	ARCADIS Result	RPD, %
MW13B	07/06/06	1,2-Dichloroethane	0.7	0.67	4
		1,2-Dichloropropane	0.5 U	0.5 U	NC
		1,3,5-Trimethylbenzene	0.5 U	1 U	NC
		1,3-Dichlorobenzene	0.5 U	0.5 U	NC
		1,3-Dichloropropane	0.5 U	0.5 U	NC
		1,4-Dichlorobenzene	0.5 U	0.5 U	NC
		1,4-Dioxane (p-dioxane)	0.9 U	1.9 U	NC
		2,2-Dichloropropane	0.5 U	1 U	NC
		2-Chlorotoluene	0.5 U	1 U	NC
		4-Chlorotoluene	0.5 U	1 U	NC
		Acetone	4 UJ	10 U	NC
		Benzene	0.5 U	0.5 U	NC
		Bromodichloromethane	0.5 U	0.5 U	NC
		Bromoform	0.5 UJ	0.5 U	NC
		Bromomethane	0.5 U	0.5 U	NC
		Carbon tetrachloride	0.5 U	0.5 U	NC
		Chlorobenzene	0.5 U	1 U	NC
		Chloroethane	0.5 U	0.5 U	NC
		Chloroform	0.5 U	1 U	NC
		Chloromethane	0.5 U	1 U	NC
		cis-1,2-Dichloroethene	0.5 U	0.5 U	NC
		cis-1,3-Dichloropropene	0.5 U	0.5 U	NC
		Dibromochloromethane	0.5 U	1 U	NC
		Dibromomethane	0.5 U	1 U	NC
		Dichlorodifluoromethane (Freon 12)	0.2 J	1 U	133
		Ethylbenzene	0.5 U	0.5 U	NC
		Hexachlorobutadiene	0.5 U	1 U	NC
		Isopropylbenzene	0.5 U	0.5 U	NC
		m,p-Xylenes	1 U	1 U	NC
		Methyl ethyl ketone	4 UJ	5 U	NC
		Methyl tert-butyl ether	2 U	0.6 J	NC
		Methylene chloride	0.5 U	1 U	NC
		Naphthalene	0.5 U	2 U	NC
		N-butylbenzene	0.5 U	1 U	NC
		n-Propylbenzene	0.5 U	1 U	NC
		o-Xylene	0.5 U	1 U	NC
		sec-Butylbenzene	0.5 U	1 U	NC
		Styrene	0.5 U	0.5 U	NC

Table 3-6
Summary of Split Samples
Omega Chemical Superfund Site

Location ID	Sample Date	Analyte Name	CH2M Result	ARCADIS Result	RPD, %
MW13B	07/06/06	t-Butylbenzene	0.5 U	1 U	NC
		Tetrachloroethene	2.8	2.5	11
		Toluene	0.5 U	0.5 U	NC
		trans-1,2-Dichloroethene	0.5 U	0.5 U	NC
		trans-1,3-Dichloropropene	0.5 U	0.5 U	NC
		Trichloroethene	0.3 J	0.26 J	14
		Trichlorofluoromethane (Freon 11)	0.5 U	1 U	NC
		Vinyl chloride	0.5 U	0.5 U	NC
MW14	07/07/06	1,1,1,2-Tetrachloroethane	0.5 U	1 U	NC
		1,1,1-Trichloroethane	0.2 J	0.5 U	86
		1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	NC
		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	290	280	4
		1,1,2-Trichloroethane	0.5 U	0.5 U	NC
		1,1-Dichloroethane	0.4 J	0.48 J	18
		1,1-Dichloroethene	200	180	11
		1,1-Dichloropropene	0.5 U	0.5 U	NC
		1,2,3-Trichlorobenzene	0.5 U	1 U	NC
		1,2,3-Trichloropropane	0.5 U	0.005 U	NC
		1,2,4-Trichlorobenzene	0.5 U	1 U	NC
		1,2,4-Trimethylbenzene	0.5 U	0.5 U	NC
		1,2-Dibromo-3-chloropropane	2 U	1 U	NC
		1,2-Dibromoethane	0.5 U	0.5 U	NC
		1,2-Dichlorobenzene	0.5 U	0.5 U	NC
		1,2-Dichloroethane	2.1	1.6	27
		1,2-Dichloropropane	0.5 U	0.5 U	NC
		1,3,5-Trimethylbenzene	0.5 U	1 U	NC
		1,3-Dichlorobenzene	0.5 U	0.5 U	NC
		1,3-Dichloropropane	0.5 U	0.5 U	NC
		1,4-Dichlorobenzene	0.5 U	0.5 U	NC
		1,4-Dioxane (p-dioxane)	11	6.6	50
		2,2-Dichloropropane	0.5 U	1 U	NC
		2-Chlorotoluene	0.5 U	1 U	NC
		4-Chlorotoluene	0.5 U	1 U	NC
		Acetone	4 UJ	10 U	NC
		Benzene	0.5 U	0.5 U	NC
		Bromodichloromethane	0.5 U	0.5 U	NC
		Bromoform	0.5 UJ	0.5 U	NC
		Bromomethane	0.5 U	0.5 U	NC

Table 3-6
Summary of Split Samples
Omega Chemical Superfund Site

Location ID	Sample Date	Analyte Name	CH2M Result	ARCADIS Result	RPD, %
MW14	07/07/06	Carbon tetrachloride	0.5 U	0.5 U	NC
		Chlorobenzene	0.5 U	1 U	NC
		Chloroethane	0.5 U	0.5 U	NC
		Chloroform	18	16	12
		Chloromethane	0.5 U	1 U	NC
		cis-1,2-Dichloroethene	0.7	0.77	10
		cis-1,3-Dichloropropene	0.5 U	0.5 U	NC
		Dibromochloromethane	0.5 U	1 U	NC
		Dibromomethane	0.5 U	1 U	NC
		Dichlorodifluoromethane (Freon 12)	0.8 J	0.5 J	46
		Ethylbenzene	0.5 U	0.5 U	NC
		Hexachlorobutadiene	0.5 U	1 U	NC
		Isopropylbenzene	0.5 U	0.5 U	NC
		m,p-Xylenes	1 U	1 U	NC
		Methyl ethyl ketone	4 UJ	5 U	NC
		Methyl tert-butyl ether	2 U	0.6 J	NC
		Methylene chloride	0.5 U	1 U	NC
		Naphthalene	0.5 U	2 U	NC
		N-butylbenzene	0.5 U	1 U	NC
		n-Propylbenzene	0.5 U	1 U	NC
		o-Xylene	0.5 U	1 U	NC
		sec-Butylbenzene	0.5 U	1 U	NC
		Styrene	0.5 U	0.5 U	NC
		t-Butylbenzene	0.5 U	1 U	NC
		Tetrachloroethene	250	230	8
		Toluene	0.5 U	0.5 U	NC
		trans-1,2-Dichloroethene	0.3 J	0.29 J	3
		trans-1,3-Dichloropropene	0.5 U	0.5 U	NC
		Trichloroethene	39 J	36	8
		Trichlorofluoromethane (Freon 11)	100	110	10
		Vinyl chloride	0.5 U	0.5 U	NC

Notes

Results reported in micrograms per liter (µg/L)

RPD - Relative Percent Difference = $\{ (CH2M - CDM) / (CH2M + CDM) / 2 \} \times 100$

RPD goal is 30

J - Estimated value.

4. Physical Characteristics of the Study Area

This section provides a general description of the site conditions including site location and topography, surface water features, climate, land use, ecological resources, and regional hydrogeology of the central basin where the former Omega facility is located. The site hydrostratigraphy was developed using the geological data acquired during the field investigations and the general hydrogeologic conditions of the study area. A description of the aquifer test results is also provided in this section.

4.1 Location and Topography

The former Omega facility is located at 12504 and 12512 East Whittier Boulevard in Whittier, California (Figure 1-1). The City of Santa Fe Springs is located southwest of the former Omega property. OU2 of the Omega Site (i.e., the plume of contaminated groundwater) extends into the City of Norwalk.

The former Omega facility is located along the base of the La Habra piedmont slope descending from the southwestern flank of the Puente Hills, at an elevation of approximately 220 feet above mean sea level (msl) (Weston, 2003). The piedmont slope descends toward the southwest at a slope of approximately 2.5 percent to an area approximately 2,800 feet southwest of the former Omega facility. In this area, the ground surface flattens into a broad basin or plain, at an elevation of approximately 150 to 155 feet msl. In the southwestern part of OU2, the ground surface rises gently to approximately 160 feet msl at the northwest end of the Santa Fe Springs plain (Weston, 2003). OU2 and surrounding areas are completely developed.

OU1 includes the former Omega facility, located at 12504 and 12512 East Whittier Boulevard, and approximately 100 feet west-southwest of Putnam Street. OU2 generally includes the groundwater contaminated area that extends from the former Omega facility approximately 4.5 miles to the south-southwest (Figure 1-4).

4.2 Surface Water Features

The San Gabriel River and the Sorensen Avenue Drain form the two principal surface water features in the study area (Figure 1-1). The San Gabriel River lies just west of Interstate 605 and generally flows from northeast to southwest. The Sorensen Avenue Drain is a small, concrete-lined drain that flows across the basin toward the southeast from a point near the intersection of Dice Road and Slauson Avenue. This channel bends toward the south beyond the limits of OU2 to become La Canada Verde Creek, which cuts through a low gap between the Coyote Hills on the east and the Santa Fe Springs plain on the west.

The San Gabriel River channel is unlined in the Montebello Forebay and the river is a losing stream in this area. The river channel is lined south of the Montebello Forebay and the recharge from the lined portion of the river is expected to be limited. Additional surface water recharge includes artificial spreading ponds adjacent to the San Gabriel River and

Rio Hondo River channels. Even before the artificial recharge program began, the Montebello Forebay was a major recharge area because of the unconfined conditions and the presence of the San Gabriel River and Rio Hondo. Recharge from other streams and storm water drains is limited because most of them are concrete lined (Reichard et al., 2003).

The San Gabriel River Watershed falls within Los Angeles County. In 1999, the Los Angeles County Board of Supervisors directed the Los Angeles Department of Public Works (LADPW) (in cooperation with the County Departments of Parks and Recreation and Regional Planning) to prepare a San Gabriel River Master Plan. A watershed management plan for the Coyote Creek sub-watershed is in development (Cal-EPA, Los Angeles Regional Water Quality Control Board, Website, <http://www.waterboards.ca.gov/losangeles>).

Several small creeks drain the southwestern slopes of the Puente Hills including the Turnbull Canyon and Wosham Creek northeast of the former Omega facility (Figure 4-1). Runoff from the Puente Hills is an expected source of increased mountain front recharge along the northeastern margin of the basin in the Whittier area.

4.3 Climate

The climate in the former Omega property area is semiarid with moderate temperatures that rarely drop below freezing. Highest temperatures generally occur during the months of July, August, and September. Rainfall occurs primarily during the winter and spring months. Figure 4-2 provides annual rainfall totals in the City of Whittier between water years 1956 and 2006. The 50-year mean annual rainfall over this time period is 14.3 inches per year (LADPW, website, <http://dpw.lacounty.gov>). The cumulative departure from the mean annual rainfall (Figure 4-2) indicates that rainfall has increased since the mid-seventies; the annual rainfall was lower in the period between 1956 and 1976 compared to the period between 1977 and 2006. The start of the period of higher than average rainfall coincides with the start of former Omega facility operations.

The 50-year mean annual infiltration rate (the fraction of rainfall that infiltrates into the subsurface and reaches groundwater) in the central basin is 1.55 inches per year. The infiltration rate is higher (2.07 inches per year) in the Montebello Forebay (between the San Gabriel River and Rio Hondo) and also at the edge of the basin, in a narrow strip along Puente Hills (Reichard et al., 2003).

4.4 Land Use

Figure 4-3 shows the current land use within and near OU2. Most of the OU2 area is used for industrial and business purposes, however, residential buildings are present in the southern portion of OU2 (south of Lakeland Road and west of Balsam Street), north of Washington Boulevard near its intersection with Crowndale Avenue, and west of the intersection of Lambert Road and Santa Fe Springs Road. Zones with residential buildings also surround OU2 on the southeast, northwest, and west.

The northern portion of OU2 was irrigated agricultural land in early 1900s (USGS, 1905) and agricultural use persisted through 1950s. The former Omega property was first developed in 1951.

4.5 Hydrogeology

This section summarizes the site regional hydrogeological setting and site-specific hydrogeologic conditions. The regional hydrogeological setting (Section 4.5.1) is largely based on the California Department of Water Resources (CDWR) Bulletin 104 (CDWR, 1961). Site conceptual hydrogeology (Section 4.5.2.6) was developed using the information on the regional hydrogeologic setting and geological data acquired during the field investigation, as well as unpublished deep seismic exploration data.

4.5.1 Regional Hydrogeology

The site is located in the Whittier area of the central basin, a sub-basin of the coastal plain of Los Angeles County. The coastal plain is bounded on the west and south by the Pacific Ocean and by mountains on the north, east, and southeast. The coastal plain is underlain by an extensive groundwater basin in Los Angeles and Orange Counties.

4.5.1.1 Hydrostratigraphy

Water-bearing sediments identified in the Whittier area extend to an approximate depth of at least 1,000 feet bgs. The identified geologic units consist of recent alluvium, the upper Pleistocene Lakewood Formation, and the lower Pleistocene San Pedro Formation. The Pliocene and Miocene marine sediments below the San Pedro Formation generally contain saline water in the Whittier area, although locally, it can contain freshwater. These units are considered nonwater-bearing where exposed in the Puente Hills and include the Pliocene Pico and Repetto Formations and the Upper Miocene Puente Formation, but are not further addressed in this report. Figure 4-4 shows a generalized stratigraphic column of fresh water-bearing sediments in the coastal plain of Los Angeles.

The recent alluvium is primarily comprised of streambed deposited gravel, sand, silt, and clay. Hydrostratigraphic units found within the recent alluvial deposits include the semiperched aquifer, the Gaspur aquifer, and the Bellflower aquiclude. The semiperched aquifer is comprised of unsaturated sand and gravel deposits and is found on or near the surface of much of the coastal plain. The most important areas where this aquifer appears are in the Los Angeles and the Montebello Forebay areas, and irregular patches throughout the rest of the coastal plain. The Bellflower aquiclude comprises all the fine-grained sediments that extend from the ground surface, or from the base of the semiperched aquifer, down to the first aquifer below. The Gaspur aquifer is mainly sand and gravel with a small amount of interbedded clay of continental origin. The Gaspur aquifer is only found within the recent alluvium. However, CDWR considers the semiperched aquifer and the Bellflower aquiclude to be present in both the recent alluvium and the upper part of the Lakewood Formation (CDWR, 1961). CDWR (1961, Plate 26A) shows Gaspur deposits extending into OU2 from the west (Figure 4-5). In the northern part of OU2, the Gaspur aquifer is shown as far as midway between MW17 and MW23, between MW7 and MW23, and at MW3 and MW14. In the southern part of OU2, the Gaspur aquifer extends to the plume south of MW28. The margin of the Gaspur aquifer in the central part of OU2 approximately coincides with the western OU2 boundary.

The Lakewood Formation consists of non-marine deposits of late Pleistocene age and its base occurs at about 70 feet at OU2 (Section BB' on Plate 6A, DWR, 1961). The Gage aquifer

is the major water-bearing hydrostratigraphic unit and comprises the basal lithologic unit of the Lakewood Formation. It consists of about 30 feet of sand with some interbedded clay (CDWR, 1961). The Gage aquifer does not appear to be an important source of drinking water in the Whittier area, based on elevated total dissolved solids (TDS) concentrations measured in groundwater samples collected at OU2; none of the local water supply wells produce water from this aquifer.

According to DWR (1961), sands and gravels with interbedded clay found underlying the Lakewood Formation are of marine origin; they are assigned to the San Pedro Formation. The base of the San Pedro Formation occurs at a depth of about 900 feet at OU2 (Section BB' on Plate 6A, DWR, 1961). The San Pedro Formation unconformably underlies the Lakewood Formation. The San Pedro Formation has been subdivided into five named aquifers separated by clay members. A fine-grained layer is also typically present at the top of the sequence; although, in localized areas, the uppermost San Pedro Formation aquifer may be merged with the overlying aquifer, and one or more of the five aquifers may also be merged (CDWR, 1961). The five aquifers defined within the San Pedro Formation include, from top to bottom, the Hollydale, Jefferson, Lynwood, Silverado, and Sunnyside aquifers. The Hollydale aquifer has been identified by CDWR (1961) only in the western portion of the Whittier area. It is merged with the overlying Gage aquifer in the vicinity of South Whittier. The other aquifers within the San Pedro Formation are thought to be present over most or all of the Whittier area. The thickness of the aquifers increases with depth. The shallow Hollydale aquifer ranges from 10 to 25 feet, whereas the deepest Sunnyside aquifer ranges from 200 to 300 feet. The base of the Sunnyside aquifer reaches a maximum depth of about 1,000 feet bgs (CDWR, 1961). The San Pedro Formation aquifers are the primary source of water for the production wells in the area.

4.5.1.2 Geologic Structures

The major geologic structures in the area include a homocline that underlies the La Habra piedmont slope, the northwest-trending La Habra syncline underlying the alluvial basin, and the west-northwest trending Santa Fe Springs (also named Coyote) anticline situated below the slightly uplifted Santa Fe Springs plain (CDWR, 1961). The anticline crest (Figure 4-5) coincides with the extent of exposed Pleistocene alluvial deposits (Saucedo et al., 2003). The La Habra syncline affects the San Pedro Formation and, to a lesser extent, the Lakewood Formation, and has a surface expression as the axis of the basin. The Santa Fe Springs anticline folds both the San Pedro and Lakewood Formations; shallow aquifers thin across the crest of the anticline. The Santa Fe Springs anticline plunges to the west-northwest and the La Habra syncline to the northwest (CDWR, 1961). Saucedo et al. (2003) and CDWR (1961) differ slightly in the location of the fold axes for both the Santa Fe Springs anticline and the La Habra syncline. The extent of the Gaspar aquifer as shown in CDWR (1961) is also consistent with the folding in the OU2 area. The Gaspar aquifer extends from the San Gabriel River channel to the east into the La Habra syncline, is absent across the Santa Fe Springs anticline, and extends to the east again along the southwestern limb of the anticline.

4.5.1.3 Faults

The west-northwest trending Whittier fault is located northeast of the site in the Puente Hills (CDWR, 1961). The Whittier fault is the closest known major fault to the former Omega

property; because this fault cuts through the Puente Formation in the Puente Hills northeast of the Omega property, it is not expected to significantly affect groundwater flow in the shallow unconsolidated deposits at OU2. The west-northwest trending Norwalk fault, located just south of OU2 (approximately along Interstate 5), is thought to act as a partial barrier to groundwater flow (Reichard et al., 2003). The Norwalk fault is also referred to as the Stearn fault and is thought to be part of the Puente Hills and Coyote Hills blind thrust fault system (Meigs et al., 2008).

4.5.1.4 Groundwater Flow

Groundwater in the Montebello Forebay flows generally to the southwest, and then turns to the south-southwest in the central basin pressure area. The groundwater flow in the central basin is mainly controlled by natural and artificial recharge in the Montebello Forebay and production pumping. Groundwater response to the increased rainfall since the mid-1970s is not readily recognized on hydrographs for groundwater monitoring wells (Reichard et al., 2003). Artesian conditions now present in the pressure area of the Central Basin extended north to MW23 prior to 1900 and to MW20 in 1903 (USGS, 1905).

4.5.1.5 Oil Fields

The Santa Fe Springs oil field occurs near the anticline crest; the extent of the oil field approximately coincides with the surface exposure of Pleistocene alluvium (Figure 4-5). The oil-bearing deposits are below the depth extent of the drinking water aquifers.

4.5.2 Site Hydrogeology

This section describes the lithology of the subsurface material at Omega OU1 and OU2, the occurrence of groundwater and flow patterns, and the major hydrostratigraphic units.

4.5.2.1 Lithology

The lithology within the Omega OU1 and OU2 areas has been characterized using borings and downhole geophysical logs. The Omega investigations targeted shallow deposits found at depths of up to approximately 200 feet; investigations at other sites within OU2 provided data from much shallower depths.

4.5.2.2 OU1 Lithology

The vadose zone at OU1 (Figure 1-3) has been characterized by a combination of soil borings and a membrane interface probe (MIP) investigation; conductivity logging was performed in most of the MIP borings. The conductivity logs and also continuous soil boring logs indicate alternating thin lenses of relatively fine- and coarse-grained soils. The soils at and immediately near the former Omega property are predominantly fine-grained from the ground surface to about 130 feet (the maximum depth drilled at well OW1B) and mostly brown. The soils were classified as silt based on grain-size distribution analysis of soil samples (CDM, 2007); visual soil classification appears to have been biased toward clays (e.g., OW1 and OW7 boring logs, Appendix A.1). The fine-grained units are likely alluvial fan deposits that originated from the southwestern slopes of the Puente Hills.

A sandy unit was found between 45 and 60 feet bgs along Putnam Street (west of the former Omega property). The unit is characterized by fine to medium sands and is up to 35 feet

thick (at downgradient well OW4). This sandy unit is not present beneath the former Omega property. This unit appears to be thin or transition into fine-grained soils (silts and clays) toward the north along Putnam Street; it is, however, continuous along Putnam Street within OU1 (CDM, 2007) and southwest from OU1. A second sand unit was found starting at about 120 feet bgs (at wells MW13, OW3B, and OW8B) along Putnam Street. Its extent beneath the former Omega property is not known. The unit appears to continue to well OW4 and farther southwest. The two sandy units consist of light brown, poorly graded sands with subangular to rounded granitic and metamorphic clast. The shallow sands at Putnam Street are fine- to medium-grained while the deeper sands are mostly medium-grained with occasional gravel.

4.5.2.3 OU2 Lithology

Near-surface soils at OU2 (Figure 1-4) consist of sands and silts that are of various shades of brown, from light olive to yellowish. The color indicates that the sediments had undergone weathering under oxidized conditions and are believed to largely consist of continental deposits. Some of the color changes and the high content of clays within the Pleistocene deposits may indicate the presence of fossil soil horizons.

Dark greenish grey, poorly to well-graded sands with intervening pale brown or olive brown sands were found below about 30 feet at wells MW19 and MW23A, below about 60 feet bgs at wells MW12, MW27, MW29, and MW30, and below about 100 to 140 feet at wells MW24, MW26, and MW28. Dark olive brown sands are present at similar or greater depths throughout OU2. The color is likely indicative of the soil oxidation states rather than of the depositional environment. The sands are fine to coarse, with occasional gravels. The clast is largely subrounded, and of granitic and metamorphic origin. The fine-grained soils found at OU2 are olive brown to greenish grey silts and clays.

The extent of the fluvial deposits shown in CDWR (1961; Figure 4-5) is supported by the OU2 investigation results. The lithologic logs for wells MW14, MW16, MW18, MW19, MW20, MW21, MW22, MW23, and MW27 describe igneous and metamorphic clast. The log for MW25 describes quartz clast. The igneous and metamorphic material is believed to have been eroded from the San Gabriel Mountains and transported by a river. The shallow fluvial deposits likely correlate with the Gaspur Aquifer. However, the fluvial material was also found at greater depths (e.g., up to 150 feet at MW16, up to 180 feet at MW23, 195 to 220 feet at MW25) indicating that these deeper deposits likely predate the Gaspur aquifer. The materials found at OU2 are not as coarse as the Holocene deposits reported in the San Gabriel River channel (CDWR, 1961).

The rocks exposed in the western Puente Hills belong to the Fernando formation of Pliocene age and to the Puente formation of Miocene to Pliocene age (e.g., Saucedo et al., 2003). They include sandstones, siltstones, conglomerates, and minor limestones and tuffs. The alluvial fan material derived from the Puente Hills has a different character than the river deposits; it is mostly finer-grained and does not include igneous and metamorphic clast (these materials could be present only as a result of secondary deposition of clast from conglomerates). The fine-grained units within OU2 are interpreted as alluvial fan deposits that originated from the southwestern slopes of the Puente Hills, namely the Turnbull Canyon and Wosham Creek northeast of the former Omega facility (Figure 4-1).

The transition from alluvial to fluvial deposits occurs throughout OU2. Alluvial fans were eroded, and sands were deposited during river incursions to the east. The fluvial sands were covered by the fan material when the river retreated. The deposition of the Lakewood formation was primarily controlled by sea level changes (Bulletin 104, page 16); during low sea level stages and increased erosion, the river eroded in its channel west of OU2 and the alluvial fans expanded. During high sea levels and lower-energy depositional environment, the river meandered and deposited sands at OU2. The main river channel likely remained west of OU2, which explains why coarse gravels and cobbles are not found at OU2.

4.5.2.4 Groundwater Levels

The depth to groundwater at OU1 and OU2 ranges from 22.90 feet bgs at well MW7 to 92.07 feet bgs at well MW27C (Table 4-1). The water table slopes from 135 feet msl at the former Omega property to about 15 feet msl (well MW30) near the southern edge of OU2, approximately 4.5 miles away.

The hydrographs for all Omega wells are shown in Appendix I.1. The water level record starts in 2001 for wells near the former Omega property; hydrographs are not shown for the wells installed in 2007 because the data record is too short. Water levels at OU1 and OU2 declined between 2001 and 2004, rebounded after heavy precipitation in 2005, and remained approximately steady in the following years. The 2005 rebound was similar in magnitude in both water table and deep well screens, with the water levels in the deep screens rebounding faster than in the shallow screens at the same locations (e.g., wells MW4, MW8, OW1, and OW4). Water levels at other sites within OU2 (Appendix I.1) follow a similar pattern over time.

At cluster wells, water levels measured in deeper screens are generally lower than water levels in shallower screens. The greatest difference between water levels in adjacent screens is 25.69 feet between wells MW25C and MW25D. Water level differences of 10 to 20 feet were measured at six locations (or wells): between OW3 and OW3B, OW8 and OW8B, MW17B and MW17C, MW20B and MW20C, MW26B and MW26C, and MW27B and MW27C; higher water elevations were measured at the shallower screens at all of these wells. The differences in the water levels indicate that at these locations, there is substantial hydraulic separation between the aquifer units screened. The water levels are nearly the same at all three screens at well MW18, indicating that there is little or no hydraulic separation of the screened units in this area.

Water table contours for the study area were developed from groundwater elevations at the shallow (water table) wells including 29 EPA monitoring wells, 8 OPOG monitoring wells, 6 WDI monitoring wells, 22 CENCO Refining Company (CENCO) monitoring wells, and 2 OFRP monitoring wells (Figure 4-6). The water level contours were generated using the natural neighbor interpolation method in SURFER 8.01 (Golden Software, Inc., 2002). This method is based on the Thiessen polygon-weighting procedure and is suitable for irregularly distributed data; it does not extrapolate outside of the data coverage. The computed contours were adjusted based on professional judgment. August 2008 water table contours for the Ashland Chemical facility (URS, 2008) were added to the OU2 water table map to extend the contours to the east.

The water table contours (Figure 4-6) indicate that groundwater flows from the former Omega property to the southwest past Sorensen Avenue, and then the flow direction changes to the south-southwest near Los Nietos Road. The flow turns further to the south at Florence Avenue and to the south-southeast past (south of) Lakeland Avenue. Section 4.5.2.6 presents an explanation of the flow pattern.

The shallow groundwater gradient between the former Omega property and Sorensen Avenue is about 0.0012 ft/ft to the southwest. The gradient becomes steeper, 0.0076 ft/ft, between Sorensen Avenue and Florence Avenue and its direction gradually turns from the southwest to the south-southwest. Near Lakeland Road, the gradient is due south. Between Lakeland Road and Imperial Boulevard, the gradient decreases to 0.0030 ft/ft and turns to the south-southeast. The gradient calculations are shown in Appendix I.2. The average shallow groundwater gradient along the flow path from the former Omega property to well MW30, the farthest downgradient well, is 0.0049 ft/ft (the difference in water levels between wells OW8A and MW30 is 119.12 ft over a distance of 24,080 ft). The areas of flat water table gradient coincide with the extent of the Gaspur aquifer, indicating that groundwater flows through more permeable materials. The gradient steepens across the anticline as groundwater flows through less permeable, largely alluvial fan material. South of the anticline the gradient flattens again as the flow re-enters the Gaspur aquifer.

Historical records from Omega and other sites suggest that the shallow groundwater flow patterns at OU2 have not changed much at least over the past decade. Local groundwater gradients measured between more closely-spaced monitoring wells at other sites are in good agreement with gradients estimated for OU2. The historical gradients are available for the following areas at OU2:

- **Omega to Sorensen Avenue** – Minimal changes in groundwater flow direction and gradients in the area covered by wells OW1 to OW8 and MW1 to MW11 were observed since 2003 (Weston, 2003; CH2M HILL, 2004).
- **North of Los Nietos Road, east of Santa Fe Springs Road** – The shallow groundwater gradient at WDI was generally to the south in the 1990s. The gradient steepens from 0.002 ft/ft in the western portion of the site to 0.035 ft/ft in the southwestern corner of the site. The water levels in shallow wells are higher than those in wells screened at greater depths; the apparent vertical gradients ranged from 0.008 to 0.052 ft/ft (EPA, 2002). The gradient at WDI was 0.002 ft/ft to the southwest in July 2007, consistent with the groundwater flow regime in the upgradient portion of OU2.
- **Sorensen Avenue to Los Nietos Road** – At Angeles Chemical, the shallow groundwater gradient was 0.005 ft/ft to the southwest in February 2004 (Shaw, 2004). At McKesson Chemical, the shallow groundwater gradient was 0.006 ft/ft to the west-southwest in November 2005 (Geosyntec, 2005). The shallow groundwater gradient at Phibro-Tech of 0.0036 ft/ft to the southwest was calculated from October 2006 groundwater elevations (Iris Environmental, 2006). At Pilot Chemical, shallow groundwater flow is generally toward the southwest at gradients ranging from 0.002 ft/ft to 0.003 ft/ft (McLaren/Hart, 1998).
- **Near Telegraph Road** – At the OFRP site, the average gradient between 1994 and 1996 was 0.0080 ft/ft to the south-southwest (it ranged from 0.0058 to 0.0135). The area with

the steepest gradient was near the intersection of Telegraph Road and Santa Fe Springs Road between former monitoring wells MW12 and MW13 (McLaren/Hart, 1996). In September 2006, the shallow groundwater gradient was 0.012 ft/ft to the west-southwest (calculated from water levels that CH2M HILL collected during semiannual groundwater monitoring); the gradient direction is probably distorted because the remaining three wells are far apart and the flow is turning to the south in this area.

- **South of Florence Avenue** – The average shallow groundwater gradient at CENCO was 0.01 ft/ft to the south between 2001 and 2005 (Versar, 2001; TRC, 2002; BBL, 2005). At the southern portion of the CENCO site, the gradient was 0.0051 ft/ft to the south-southeast in July 2007 (calculated from data received electronically from DTSC).

4.5.2.5 Stratigraphic Boundaries

The stratigraphic interpretation is based on available boring logs and downhole geophysical logs of the OU1 and OU2 monitoring wells and nearby production wells and piezometric heads. In addition, the OU2 stratigraphic interpretation relied on information on the deeper structure of the basin to infer the locations of fold axes and the dip of hydrostratigraphic units. USGS provided a preliminary interpretation of oil industry seismic reflection surveys and of the shallow sediments at OU2 based on the data collected during this RI (USGS, 2007). The seismic survey covered an area larger than OU2. The data show major seismic reflectors (soil density contrasts that reflect sound waves) below 300 feet and were used to support geophysical log and lithologic correlations of shallower units, particularly the location of the fold axes and the dip of stratigraphic units. USGS performed this work for EPA under Contract DW 1495567601.

A site lithologic and stratigraphic model has been developed and is illustrated by the cross-sections AA', BB', and CC' (Figure 4-7). Sections AA' and CC' are oriented sub-parallel, and BB' is oriented perpendicular to the major groundwater flow direction. Figure 4-7 also shows the location of the cross-sections in relation to the major geological features, including the La Habra syncline and the Santa Fe Springs anticline presented in Figure 4-5.

The locations of the fold axes and their plunge were inferred from the seismic sections. The dip of the shallow deposits was inferred from the correlation of the geophysical logs and the location relative to the fold axes.

Eight stratigraphic boundaries (SBs) have been defined for OU2. These boundaries separate stratigraphic units and some of them may represent depositional sequence boundaries. The SBs are numbered sequentially from the top, starting with SB1 corresponding to the base of Holocene deposits; similarly, SBs 2 to 7 correspond to the Pleistocene deposits. The age of the underlying deposits (below SB7) is undetermined in this report as age determination was not the focus of this investigation.

One Holocene and six Pleistocene stratigraphic units were identified through OU2. The deposition of the units is thought to be largely controlled by base level changes; consequently, lateral facies transitions reflect different depositional environments (for example, near-shore marine, floodplain, etc.) within each stratigraphic unit. Coarse sand units formed where fluvial channels dissected the floodplain or, possibly, as shallow marine (beach, proximal delta, and near-shore) deposits. A thin veneer of recent alluvium derived from the Puente Hills covers the floodplain sediments at and northeast of the former Omega

property. Generally, coarser materials are found at the base of the stratigraphic units that transition upward into finer-grained materials, as indicated by relatively high and low resistivity, respectively, on geophysical logs. This stacking pattern suggests most of these deposits are of floodplain, rather than of marine origin.

As shown in sections AA' and CC', the main structural features identified at OU2 are the La Habra syncline and the Santa Fe Springs anticline. The principal Santa Fe Springs anticline crest lies between wells MW25 and MW26; the La Habra syncline axis is near well MW15. Both fold axes are near to their locations shown in Saucedo et al. (2003). The sections indicate that the syncline and anticline are related, so the deformations are of the same age, with folding seen postdating the deposition of both the Lakewood and San Pedro formations. However, the thickening of the Holocene in the basin and unit thinning over the anticline crest indicate that folding was also syn-depositional at least since San Pedro.

4.5.2.6 Conceptual Hydrogeology

The conceptual hydrogeology is based on available boring logs and downhole geophysical logs of the OU1 and OU2 monitoring wells and nearby production wells, piezometric heads, and contaminant concentrations. The piezometric head symbols in Figure 4-7 are color-coded to show which stratigraphic unit each well is screened in (the symbols have the same color as the underlying SB). A listing of screen depths and water levels is provided in Table 4-1. Figure 4-8 shows the depth extent of PCE in groundwater. The contaminant distribution is discussed in detail in Section 5.

Fine-grained units are shown on the cross-sections where geophysical logs indicated their presence and where piezometric heads or contaminant distribution suggest hydraulic separation of the screened zones. The presence of these aquitards is also generally supported by the visual description of drill cuttings. Aquitards are generally not contiguous over OU2 as indicated by piezometric heads (e.g., wells MW18 and MW23) and contaminant distribution (e.g., well MW23). Only one aquitard is manifested by differences in piezometric heads at most well locations; however, the head drop occurs at different depths at different well clusters indicating that there is no single, continuous aquitard present at OU2.

Near-surface fine-grained soils are also found in the vicinity of the former Omega property and are depicted on section AA'.

Unsaturated Holocene deposits (above SB1) are found at and near the former Omega facility and in the downgradient area of OU2 (sections AA' and CC'). The Holocene deposits are absent across the anticline (between wells MW25 and MW27).

As illustrated by cross-section AA', the former Omega facility is underlain by relatively low permeability silty and clayey soils to a depth of about 120 feet bgs. These fine-grained soils transition into a sand unit that has been encountered approximately 200 feet southwest of the facility beneath Putnam Street; this unit contains the shallowest groundwater near the facility. Groundwater at OU1 generally occurs at a depth of approximately 70 feet bgs. A deeper aquifer unit was found at a depth of about 112 feet bgs along Putnam Street. The shallow aquifer is composed of well-sorted, fine to medium sands, and the deeper aquifer is composed of fine, well-sorted sands with interbedded silts and clays along Putnam Street. Piezometric heads in the deeper aquifer (below SB2) are about 7 to 13 feet lower compared

to the heads in the water table aquifer in this area (based on July–August 2007 measurements), indicating substantial hydraulic separation between the two units.

A distinct lithologic horizon at an approximate depth of 30 feet bgs (referred to as the 30-foot unit) was found at OU1 dipping to the west and southwest. The 30-foot unit is between 3.5 to 11 feet thick and has a characteristic double peak signature on the MIP conductivity logs, with a lower conductivity interval in the middle of the unit likely corresponding to coarser materials and higher conductivity below and above, possibly due to higher clay content. The top of the zone slopes generally to the west-southwest beneath the former Omega property (CDM, 2007). The 30-foot marker bed is near the top of HSU2 and likely is an overbank deposit. It was also recognized on gamma logs at OU1, but its extent outside OU1 is not known.

Away from the former Omega facility, an unsaturated coarse unit (above SB2) was found near the surface at the locations of well clusters MW16, MW17, and MW20. The apparent dip of this unit suggests that it was affected by the uplift demonstrated by the Santa Fe Springs anticline, and is therefore considered to be part of the Lakewood Formation. This unit likely becomes saturated south of well MW30 and west of well MW22. The sediments above SB3 form the first saturated sandy unit within most of the study area, approximately between wells MW23 and MW30.

Section BB' shows that the degree of vertical hydraulic separation varies over OU2, as seen in uniform piezometric levels at well MW18. The fine-grained units pinch out or transition into coarser grained sediments between wells MW23 and MW18. The orientation of the SBs in Section BB' is a manifestation of the anticline plunging northwest. Section BB' shows diminished correlation of lithologic units relative to the unit correlation along Sections AA' and CC', which supports the interpretation that the sediments are part of an alluvial fan complex. The lateral termination of the intervening aquitards can allow vertical hydraulic communication between aquifer units; because of generally downward gradients, shallow groundwater is expected to enter into the underlying units in areas where aquitards are missing.

The site hydrogeologic model generally matches the regional hydrogeology as described in the CDWR Bulletin 104. It is consistent with OU2 being largely located in the recharge area of the Los Angeles basin, in a transition zone between the piedmont slope (alluvial fan) and the margins of the floodplain (Montebello Forebay). The hydrogeologic interpretation based on the seismic survey and Omega investigation data differs in details from the regional hydrogeology described in CDWR (1961). SB6 may represent the contact between the Lakewood Formation and the San Pedro Formation. No correlation of the sandy units with regionally recognized aquifers (e.g., Gage Aquifer, etc.) was attempted.

The shallow, unconfined aquifer spans two stratigraphic units. Piezometric heads measured in OU2 wells generally, but not always, decline with the depth of the hydrostratigraphic unit that the well is screened in; the differences between heads at multiple-screen wells are up to about 25 feet (based on July–August 2007 measurements). Vertical head differences between shallow and deeper well screens along Putnam Street are over 10 feet, indicating hydraulic separation between the shallow and deeper sands. Farther northeast of the Omega facility, near the apex of the alluvial fan complex along the Puente Hills, hydraulic

continuity across the shallow unconsolidated deposits may be expected because of the generally coarser alluvial fan material.

The groundwater gradient in the sand below SB5 is 0.0049 to 0.013 ft/ft to the southwest (measured between wells MW16C, MW17C, MW20C, MW23D, and MW25C; see Appendix I.2). The gradient is steeper but generally in the direction of the shallow groundwater gradient in this area. This flow pattern is expected for a layered aquifer system where production pumping from deep units dominates the groundwater flow regime. Based on the gradient, PCE distribution, and piezometric head drop at most well locations across SB5, it appears that the fine-grained material below SB5 is a laterally continuous aquitard at OU2, at least along the sections constructed.

The groundwater gradients measured in the sands between SB3 and SB5 were inconsistent, indicating that the intervening fine-grained units provide local hydraulic separation.

The effect of the syncline on groundwater flow at OU2 is manifested by the area of flattened groundwater gradient between wells OW8 and MW8, which coincides with the extent of the Gaspur aquifer. The anticline seems to have even more significant influence on groundwater flow and contaminant transport at OU2. The contaminant plume and the groundwater flow curve to the south around the Santa Fe Springs anticline, and there is a fairly sharp increase in the shallow groundwater gradient that more or less coincides with the curve in the plume. This transition also coincides with mapped changes in surface geology related to the anticline (Saucedo et al., 2003).

The increased shallow groundwater gradient around the anticline can be explained by forcing groundwater to flow across the units north of the anticline axis (e.g., between wells MW23 and MW16 on Section AA' and between wells MW23 and MW25 on Section CC') and causing the uppermost Pleistocene unit to change from an unconfined to confined aquifer south of the anticline crest. The flow across the unit will result in the steepening of the gradient because the permeability (vertically) across the units is expected to be much lower than parallel to their depositional direction. When a unit changes from an unconfined to confined condition, its restricted saturated thickness results in the steepening of the groundwater gradient.

South of the anticline, the gradient flattens again as the flow re-enters the Gaspur aquifer. The groundwater flow southwest of the anticline is also likely more influenced by the regional flow in the Central Basin which is toward the south-southwest. Therefore, the change in the groundwater flow direction south of the anticline crest may be the result of transitioning from a pure piedmont slope flow (from the natural infiltration areas at the foothills of the Puente Hills to the southwest) to the basin flow regime that is affected by infiltration in the Montebello Forebay and production pumping in the Central Basin.

4.5.2.7 Hydrostratigraphic Interpretation at Other Sites

Regional aquifer units were identified during environmental investigations at other sites within OU2. The conclusions made by various consultants were based on site investigation data and also on the consultants' interpretation of CDWR, 1961. CH2M HILL compiled these assessments of shallow local hydrogeology (Attachment 1) as part of the process of acquisition of information from other sites within OU2. The comparison of the site assessments shows that the correlation of local hydrogeology with regionally recognized

aquifers is ambiguous, for example, as shown from the description of the aquifer units at the Angeles, McKesson, and Phibro-Tech sites (e.g., the Gaspur aquifer is identified at the Angeles site, but not at the adjacent McKesson site; the Gage aquifer is described as saturated at the Angeles and McKesson sites, but as unsaturated at the Phibro-Tech site, yet this unit dips from Angeles/McKesson to Phibro-Tech, etc.). The discrepancies in the interpretation of hydrogeology for the individual sites only became apparent when they were reviewed together.

4.5.3 Aquifer Properties

Aquifer properties were estimated during several previous investigations at OU2.

4.5.3.1 Results of Previous Aquifer Testing

Aquifer tests that have been performed in Omega wells at OU1 included slug tests and pumping tests.

Short-term constant discharge testing (approximately 4 hours) was performed on wells OW2, OW3, OW4a, and OW8 in 2003. The estimated transmissivity values were 170 square feet per day (ft^2/d) for well OW2; 2,691 ft^2/d for well OW4A; and 1,616 ft^2/d for well OW8A, and the OW3 test was not analyzed (CDM, 2005). An approximately 24-hour long constant rate pumping test was conducted in 2003 on well OW8A with drawdown monitored in several observation wells/piezometers and yielded estimates of transmissivity between 563 and 810 ft^2/d (CDM, 2005).

A constant discharge test of approximately 24-hours long was performed in September 2006 on five extraction wells installed along Putnam Street in mid-2006 (wells EW1 through EW5) as part of the Phase 1a area interim groundwater remedy. Drawdown was also measured at multiple observation wells. The geometric mean hydraulic conductivity of the unconfined sandy unit calculated from the extraction well testing was 153 ft/d and the geometric mean transmissivity was 2,760 ft^2/d (CDM, 2006). The estimated conductivity is representative of the unconfined aquifer formed by the shallow sandy unit.

Hydraulic conductivity values of 0.6 to 1.6 ft/d were estimated from a slug test at well OW1A and step-drawdown pumping test at well OW2 (Weston, 2003). Well OW1A is installed in fine-grained sediments, largely silts, and well OW2 is screened across sand and silt near the termination of the shallow sandy unit; the estimated hydraulic conductivities are representative of the shallow fine-grained sediments near the former Omega property. The hydraulic conductivity of 1.6 ft/d for well OW2 is lower than the value corresponding to the transmissivity that CDM estimated (8.5 ft/d for a screen length of 20 feet) (CDM, 2005).

Slug tests were performed on several wells at the McKesson facility. Due to very high hydraulic conductivity, the recovery response of the slug tests was too quick to allow for their analysis; the subsequent testing included constant rate pumping tests. The hydraulic conductivity of the perched zone was estimated to be 0.6 ft/d . The hydraulic conductivity of the lower aquifer zone ranges from 9 to 59 ft/d (Harding Lawson Associates, 1991).

McLaren/Hart Inc. conducted slug tests and estimated the hydraulic conductivity of the shallow, unconfined aquifer at the OFRP site to range between 3 and 97 ft/d with a mean of 23 ft/d . The shallow aquifer transmissivity estimated from observation well data for a

constant-rate pumping test using two observation wells at a distance of 24 feet from the pumping well MW10, ranged between 0.84 and 1.2 square feet per minute (ft²/min). No drawdown response was recorded at 136 feet from the pumping well (McLaren/Hart, Inc., 1996). Assuming a saturated thickness of 20 feet, the hydraulic conductivity would be between 60 and 86 ft/d.

The hydraulic conductivity of the shallow aquifer at Phibro-Tech is 55 to 307 ft/d and storativity is 0.01 to 0.009 (CDM, 2003). The storativity value seems to be overestimated for the shallow aquifer thickness.

4.5.3.2 Results of OU2 Aquifer Testing

CH2M HILL performed slug tests and pumping tests to characterize hydraulic conductivity distribution within OU2 as part of this investigation.

Slug Test Results

Slug tests were performed in all Omega wells and analyzed using the Kansas Geological Survey model (KGS; Hyder *et al.*, 1994), Butler (1998) method, and Bouwer and Rice (1976) method. The results are summarized in Table 4-2. The testing procedures and analysis are presented in Appendix H.1. Table H1-3 shows the methods used for each well in addition to the results of each parameter. The average horizontal hydraulic conductivity (K_r) for all wells is 54 ft/day. The minimum K_r of 0.5 ft/day was estimated for well MW24D and the maximum of 264 ft/day for well MW2. The average K_r for the shallow (water table) wells is higher, 68 ft/day (Table H1-5), than for the deeper wells, 40 ft/day (Table H1-6).

Pumping Test Results

Pumping tests were performed at 6 wells, primarily along the main contaminant transport pathway from the former Omega property at locations where future remedial pumping may be considered. The drawdown response to pumping in the extraction wells stabilized quickly at all the tested locations, indicating that the wells are installed in permeable aquifer material. These wells were screened in sand units that likely represent the most permeable aquifer material at OU2. The well screens were not installed in fine-grained materials that comprise a significant portion of the sediments at OU2. Therefore, the aquifer properties estimated from the pumping tests are characteristic of the material within the main contaminant transport pathway, but not of the bulk aquifer properties in the basin. The results are summarized in Table 4-3. The test analysis is presented in Appendix H.2.

The tests at nested wells and well clusters allowed the evaluation of hydraulic continuity of the aquifer near the tested wells. During the EW-1 pumping tests, all four well screens at well MW8 were monitored. Wells MW8A, MW8B, and MW8C responded to the pumping while well MW8D did not. The drawdown responses and model-fitting (Appendix H.2) indicated that the units screened by the upper three screens at well MW8 (A–C) responded hydraulically as one aquifer. The aquifer zone screened by well MW8D is separated by fine-grained sediments from the overlying unit. This conclusion is further supported by the difference in heads and contaminant concentrations measured in well MW8D and those measured in the three shallower wells (MW8A–C).

During the pumping tests at nested wells (MW23A, MW24A, MW24C, MW26A, MW26B, MW27A, MW27B, and MW30), water levels in adjacent screen intervals (above and below, as applicable) were monitored with pressure transducers. Drawdown response was

recorded at well MW24B during pumping from well MW24C, indicating hydraulic communication between the two screened zones. No other observation wells responded to pumping, indicating that the fine-grained units between the well screens act at least as partial groundwater flow barriers. The drawdown response at well MW24 indicated that the fine-grained unit separating wells MW24B and MW24C is not an effective barrier to groundwater flow and contaminant migration. The fine-grained unit between wells MW24A and MW24B likely is a barrier to groundwater flow, as evidenced by the lack of hydraulic response and also by the difference in head and contaminant concentrations. Wells MW24C and MW24D are likely separated by a low permeability unit because no response to pumping from well MW24C was recorded in well MW24D. No drawdown response in the adjacent screens was recorded during the pumping tests at wells MW26 and MW27, indicating that the well screens are hydraulically separated by intervening fine-grained layers.

The time-drawdown data were analyzed using the general well function (GWF; Perina and Lee, 2006) for pumping from partially penetrating wells installed in confined, unconfined, or leaky aquifers. GWF accounts for well skin properties; frictional well loss is included as an additional drawdown component (e.g., Kawecki, 1995). The plots of observed and computed time-drawdown data are included in Appendix H.2 and the estimated aquifer properties are summarized in Table H2-1. All the tests were analyzed as a confined aquifer response including those conducted on shallow (water table) wells because of the short duration of pumping.

The representative K_r results range from a minimum value of 45 ft/day at well MW27B to 404 ft/day for well EW1. The K_r values are higher than those estimated from slug tests on the same wells. This is a common test outcome because the hydraulic disturbance caused by pumping is expected to affect a much larger section of the tested aquifer than the disturbance from the slug tests, more flow pathways (i.e., zones of relatively high K_r) were active during the pumping than during the slug tests. The average specific capacity of the pumped wells is 62 gpm/ft.

The drawdown response in observation wells at the EW1 test location allowed for the estimation of the vertical to horizontal anisotropy ratio K_z/K_r (and other parameters, see Appendix H.2). The low estimated K_z/K_r ratio of 0.0092 is indicative of the layering in the aquifer with alternating coarse and fine-grained soils (i.e., sands and silts/clays). Such low vertical hydraulic conductivity K_z also explains head differences between shallow and deep-screened wells (e.g., at wells MW8A–D) and is expected to limit the downward migration of contaminants. Low K_z/K_r is also expected to be applicable to large-scale groundwater flow (i.e., for flow across fine-grained subunits) throughout OU2.

Aquifer Properties at OU2

The estimated aquifer properties are representative of coarse-grained sub-units because the monitoring wells were installed with screens across coarse soil intervals. Furthermore, the pumping tests were conducted on wells installed in thick sandy units and located along the suspected main contaminant transport pathway (see Section 6). Therefore, the estimated hydraulic conductivities are biased toward the properties of these coarse-grained sub-units. Because these sub-units have likely been formed by river channels, they are expected to be elongated in the southwest direction; although the channels are likely interconnected, they are expected to have somewhat limited lateral extent. The K_r of the shallow, coarse sub-

units is on the order of 100 ft/d. The bulk aquifer material, on the basin scale, is expected to have lower hydraulic conductivity in proportion to the thickness of the fine-grained and coarse-grained units. The regional groundwater flow is expected to be reflective of the bulk aquifer properties, while the transport of contaminants at OU2 is expected to be largely dependent on the properties of the coarse-grained sub-units that provide the main transport pathways.

The principal orientation of hydraulic conductivity is expected to be parallel with the SBs. The permeability across the stratigraphic units is expected to be generally lower because of sediment particle orientation and also because of the presence of fine-grained sub-units (i.e., clayey and silty lenses) and more laterally extensive aquitards. However, the hydraulic properties of individual stratigraphic units are also expected to vary laterally due to facies changes from coarse-grained to fine-grained materials. The potential for vertical hydraulic communication is increased where coarse facies of overlying stratigraphic units are adjacent (e.g., near well MW18).

Horizontal anisotropy was not detected in the one multiple-well test (at EW1), likely because of the proximity and number of the test wells and because of aquifer heterogeneity. The OU2 deposits are expected to exhibit horizontal anisotropy of varying orientation throughout the OU2 area; however, designing aquifer tests to estimate the horizontal anisotropy on OU2's scale is not practical.

The specific storage and specific yield could not be reliably calculated from the test data; however, these aquifer properties can be constrained to a fairly narrow range of plausible values for the unconsolidated sediments found at OU2 (Appendix H).

4.6 Water Production Wells

Based on a records search by England-Hargis, there are six water supply wells within 1.5 miles of the Omega facility (England and Hargis, 1996). The nearest well, 02S/11W30-R3, also known as SFS No. 1, is located 1.3 miles to the west-southwest of the Omega facility, at the Santa Fe Springs Fire Station on Dice Road near Burke Street. This well is screened from 200 to 288 feet bgs and 300 to 900 feet bgs, and operates at a rate of approximately 900 gpm. According to Weston, aquifers that are tapped by SFS No. 1 include the Silverado and Sunnyside aquifers, both of which occur within the lower part of the Lower Pleistocene San Pedro Formation (Weston, 2003). However, as shown in Cross-section B-B', SFS No. 1 appears to receive a portion of its water from HSU5, which contains high VOC concentrations at well MW23C (located 0.4 miles east-southeast of SFS No. 1).

The Los Nietos water supply well (02S/11W30-Q5) was located about 1.5 miles southwest of the former Omega facility (about 1,500 feet west-northwest of SFS No. 1). This well was screened from 152 to 370 feet bgs. PCE and TCE were detected at unknown concentrations from 1986 to 1990 (Weston, 2003). The source of this contamination is unknown. The total depth of the well was 225 feet when it was destroyed in 1997 (Mutual Water Owners Association of Los Nietos, 1997). The well locations are shown in Figure 2-1.

The remaining wells (2S/11W-29E5, 2s/11W-32G3, 2S/11W-33M1, and 2S/11W-32J4) are no longer operating, used for irrigation, have no water-quality data available, or their exact locations are unknown (Weston, 2003).

Figure 4-9 shows water supply and irrigation wells that were mapped throughout OU2 in early 1900s (USGS, 1905). No records of the status, destruction, or abandonment of these wells were available at the time of the preparation of this report. Because the artesian area extended as far north as MW23 prior to 1900 and water table near the former Omega property in 1901 was about 25 feet higher than today (USGS, 1905), it is likely that many of these wells were shallow. The wells installed between MW23 and the former Omega property, an unconfined area prior to 1900, were likely screened starting at the water table.

4.7 Oil Wells

OU2 overlaps the central portion of the Santa Fe Springs Oil Field (Figure 4-10). The California Department of Conservation, Division of Oil and Gas (Website, <http://gis.ca.gov/catalog/BrowseCatalog.epl?id=1064>) lists a total of 1,378 wells in the Santa Fe Springs Oil Field. Some of these wells are active, but a majority of them were abandoned. It is possible that oil production wells abandoned prior to about 1965 were not completely sealed (they were likely pressure grouted in the production interval, but not all the way to the ground surface) and that their corroded and collapsed steel casings could provide conduits for downward groundwater flow and contaminant migration.

Attachment 1—Hydrogeology of Other Sites at OU2

The following is a summary of occurrences of the major aquifers, as interpreted by various other parties during site investigations.

Angeles Chemical

The Gaspur aquifer is listed as being impacted by chemicals near the former Angeles Chemical site (Blakely, 2004). The Gaspur aquifer is described as the old San Gabriel river and other old river channel deposits; it is 40 ft thick with its base about 80 to 100 ft bgs at the Angeles site. The Gaspur aquifer may be hydraulically connected with the Gage or Hollydale aquifers (Shaw, 2004). The Gage aquifer is impacted by chemicals near the former Angeles Chemical site (Blakely, 2004). The Gage and/or Hollydale aquifers were encountered at 20 to 35 ft bgs; they are undistinguished and site monitoring wells are described as Gage/ Hollydale monitoring wells (Blakely, 2002). The Gage aquifer is not present at the former Angeles Chemical site (Shaw, 2004). The Hollydale aquifer is impacted by chemicals near the former Angeles site (Blakely, 2004). The Hollydale aquifer is approximately 30 ft thick with its top at about 70 to 100 ft bgs (Shaw, 2004).

McKesson Chemical

The former McKesson Chemical site is underlain by silt and clay, silty sand, and sand to a depth of at least 140 ft bgs. The coarse-grained water-producing units are contained within three zones, which have been correlated with the Gage, Hollydale, and Jefferson aquifers. Geomatrix defines these respective units as the perched zone, A zone, and B zone (Geomatrix, 1995). The fine-grained units that separate the coarse-grained units consist of silt and clay (Geomatrix, 1995). The Gage aquifer is approx 30 ft thick at the McKesson site and vicinity (Harding Lawson Associates, 1991). The Hollydale aquifer has a maximum thickness of 100 ft in this area. The Jefferson aquifer underlies the Hollydale aquifer at the site; they are separated by aquicludes of the San Pedro Formation. The Lynwood, Silverado, and Sunnyside aquifers are the three main deep aquifers that range in thickness from 50 to 500 ft; however, no site borings penetrated into these units (Harding Lawson Assoc, 1991).

Phibro-Tech, Inc.

The Gage aquifer is unsaturated, approximately 15 ft thick with its top at 15 to 30 ft bgs at Phibro-Tech. The Hollydale aquifer is approximately 40 ft thick beneath the site with its top at 50 to 100 ft bgs. Sixteen of the site monitoring wells are screened in the upper portion of the Hollydale aquifer and six wells are screened in the lower portion. Well MW15D may be screened in both Hollydale and Jefferson as the two aquifers possibly merge in the southwest portion of the site. Groundwater appears to flow from the Hollydale aquifer into the

underlying Jefferson aquifer below the Phibro-Tech site. The Jefferson aquifer underlies and potentially merges with the Hollydale aquifer at the site. Because no site wells are screened in the Jefferson aquifer, its thickness is unknown (CDM, 2003).

Pilot Chemical Corporation

The Gaspur aquifer extends from approximately 50 to 100 ft bgs at the former Pilot Chemical site. The top of the Gardena aquifer is at a depth of approximately 110 ft bgs. The two aquifers are separated by clayey units. The nearest drinking water well taps the Gardena aquifer. (CH2M HILL, 1986); this well is not identified, but its location (1/4 mile northwest from the former Pilot Chemical property) corresponds to the location of Santa Fe Springs Well No. 1 (SFS No. 1).

Waste Disposal Inc.

Recent alluvium with a maximum thickness of 80 feet is near the site. This alluvium overlies the Lakewood Formation (Artesia and Gage aquifers) and San Pedro Formation (Hollydale, Jefferson, Lynwood, Silverado, and Sunnyside aquifers). The thicknesses or depths of the aquifers are not specified (TRC, 2001). If present beneath the WDI site, the Hollydale aquifer would first be encountered from 85 to 100 feet bgs (CDM, 1999).

Site F

The Gaspur aquifer is found at approximately 50 ft and the top of the Gardena aquifer is at a depth of 143 ft at West Bent Bolt (CH2M HILL, 1990).

76 Station

The 76 Station is located at 11026 East Washington Boulevard in Whittier. Recent alluvium is present to 120 feet bgs at the former 76 Station, with the Gaspur aquifer comprising approximately 80 feet of the alluvium thickness. The underlying Lakewood Formation is approximately 50 feet thick (TRC, 2004).

CENCO

The presence of the Hollydale aquifer is noted, but not its depth (TRC, 2002).

OFRP

Localized perched aquifers were found at shallow depths (Kleinfelder, 1986). The first saturated zone (starting at about 60 feet bgs) was correlated with the Exposition aquifer; the Exposition and Gage aquifers appear to be merged and could not be distinguished at the site (McLaren/Hart, 1996).

Table 4-1

Summary of Water Levels and Stratigraphic Units

Omega Chemical Superfund Site

Well Name	SB	Depth to Screen Top (feet bgs)	Depth to Screen Bottom (feet bgs)	Depth to Water Jul-Aug 2007 (feet)	Water Level Elevation (feet msl)
OW1A	2	63	77.5	76.17	136.33
OW1B	3	110	120	77.68	129.5
OW2	2	60	80	68.6	133.7
OW3A	2	63	83	64.81	133.72
OW3B	3	112	122	76.5	120.56
OW4A	2	49.8	69.8	57.88	126.79
OW4B	3	112	122.3	64.42	120.08
OW5	2	30	50	30.67	123.49
OW6	2	38	58	46.78	125.96
OW7	2	70.9	90.9	76	138.21
OW8A	2	60.4	80	66.7	133.94
OW8B	3	116	126	79.86	120.96
MW1A	2	45	60	33.55	124.16
MW1B	3	75	85.4	33.42	124.63
MW2	2	45	60	30.08	124.13
MW3	2	38	48	28.76	122.72
MW4A	2	42.7	53	25.51	121.29
MW4B	3	69.7	80	25.49	121.35
MW4C	3	88.7	99	27.32	119.78
MW5	2	43.3	53.3	27.55	123.05
MW6	2	37.1	47.5	27.5	122.78
MW7	2	35.8	46	22.9	120.38
MW8A	2	30	45	28.91	121.23
MW8B	3	65	75	28.73	121.3
MW8C	3	86.7	91.7	29.63	120.4
MW8D	4	110	120	34.63	115.28
MW9A	2	25	35	27.39	121.45
MW9B	2	49.8	60	32.28	116.62
MW10	2	52	62	33.96	113.49
MW11	2	40	50	36.59	114.3
MW12	2	82	97	83.53	137.34
MW13A	1-2	56	66	dry	
MW13B	3	123	133	83.26	122.62
MW14	2	60	75	46.78	125.85
MW15	2	50	70	25.49	122.79
MW16A	3	45	60	47.11	106.08
MW16B	5	106	116	48.23	104.96
MW16C	6	149	164	51.69	101.57
MW17A	3	56	71	64.11	94.92
MW17B	4	94	104	63.66	95.24
MW17C	6	172	182	81.24	77.76
MW18A	2-3	56	71	27.48	116.25
MW18B	5	90	100	27.45	116.38
MW18C	6	146	161	30.38	113.45
MW19	3	56	71	68.22	90.51
MW20A	3	75	90	66.84	74.47
MW20B	4	122	132	67.32	74
MW20C	5	180	190	85.85	55.5

Table 4-1

Summary of Water Levels and Stratigraphic Units

Omega Chemical Superfund Site

Well Name	SB	Depth to Screen Top (feet bgs)	Depth to Screen Bottom (feet bgs)	Depth to Water Jul- Aug 2007 (feet)	Water Level Elevation (feet msl)
MW21	3	64	79	50.96	77.85
MW22	3	74	89	63.25	87.57
MW23A	2	35	55	28.17	120.59
MW23B	3	82	97	29.25	119.81
MW23C	5	145	160	32.98	116.09
MW23D	6	175	185	33.4	114.64
MW24A	2	50	70	37.01	125.03
MW24B	3	110	125	42.08	119.95
MW24C	5	140	160	42.41	119.61
MW24D	6	173	178	42.64	119.41
MW25A	3	45	65	37.8	110.1
MW25B	4-5	90	110	38.09	109.75
MW25C	6	140	150	41.85	106.01
MW25D	7	194	209	67.55	80.32
MW26A	3	70	90	67.04	88.58
MW26B	4	105	120	67.12	88.33
MW26C	6	145	160	80.55	74.86
MW26D	6	185	205	82.44	72.93
MW27A	3	90	110	76.97	62.27
MW27B	4	144	164	76.84	62.34
MW27C	5	180	190	92.07	47.1
MW27D	5	200	210	91.85	47.28
MW28	3	85	105	74.29	45.62
MW29	3	90	110	81.03	26.07
MW30	2-3	95	115	91.88	14.82
EW1	3	65	75		

Notes:

HSU = Hydrostratigraphic Unit

bgs = below ground surface

msl = mean sea level

Table 4-2

Slug Test Results

Omega Chemical Superfund Site

Well ID	Method of Analysis	K (ft/min)	K (ft/day)
MW1A	Butler	0.1554	224
MW1B	KGS	0.0040	5.7
MW2	Butler	0.1832	264
MW3	KGS	0.0053	7.7
MW4A	Butler	0.0979	141
MW4B	Butler	0.0260	37.4
MW4C	KGS	0.0272	39.2
MW5	KGS	0.0388	55.9
MW6	B&R, Butler	0.1349	194
MW7	Butler	0.1440	207
MW8A	KGS	0.0790	114
MW8B	KGS	0.0261	37.6
MW8C	KGS	0.0335	48.2
MW8D	KGS	0.0104	15.0
MW9A	KGS	0.0009	1.3
MW9B	KGS	0.0366	52.7
MW10	Butler	0.0267	38.5
MW11	B&R	0.0591	85.2
MW12	B&R	0.0005	0.8
MW13B	Butler	0.0916	132
MW14	Butler	0.0777	112
MW15	KGS	0.0014	2.0
MW16A	B&R	0.0101	14.5
MW16B	Butler	0.0742	107
MW16C	KGS	0.0132	19.0
MW17A	KGS	0.0011	1.6
MW17B	Butler	0.0732	105
MW17C	KGS	0.0196	28.2
MW18A	Butler	0.0192	27.7
MW18B	Butler	0.0254	36.5
MW18C	KGS	0.0035	5.1
MW20A	Butler	0.0299	43.0
MW20B	Butler	0.0879	127
MW20C	Butler	0.0833	120
MW21	Butler	0.0353	50.8
MW22	Butler	0.0275	39.6
MW23A	B&R	0.0104	15.0
MW23B	KGS	0.0042	6.0
MW23C	KGS	0.0033	4.8
MW23D	KGS	0.0059	8.5
MW24A	Butler	0.0547	78.7
MW24B	Butler, KGS	0.0119	17.1
MW24C	KGS	0.0315	45.4
MW24D	KGS	0.0003	0.5
MW25A	B&R	0.0365	52.5
MW25B	KGS	0.0047	6.8
MW25C	KGS	0.0006	0.9
MW25D	Butler	0.0571	82.2
MW26A	B&R	0.0355	51.1
MW26B	Butler	0.0588	84.7

Table 4-2

Slug Test Results

Omega Chemical Superfund Site

Well ID	Method of Analysis	K (ft/min)	K (ft/day)
MW26C	KGS	0.0014	2.0
MW26D	Butler, KGS	0.0046	6.6
MW27A	B&R	0.0103	14.8
MW27B	Butler	0.0084	12.0
MW27C	KGS	0.0015	2.1
MW27D	Butler	0.0688	99.1
MW28	Butler	0.0194	27.9
MW29	Butler	0.0459	66.0
MW30	Butler	0.0416	59.9
OW3B	Butler	0.0050	7.1
OW4A	KGS	0.0188	27.1
OW4B	KGS	0.0116	16.6
OW5	KGS	0.0409	58.8
OW6	Butler	0.0685	98.6
OW7	B&R	0.0007	1.0
OW8B	Butler	0.0261	37.6

Notes:

B&R = Bouwer and Rice (1976)

Butler (1998)

KGS (Hyder et al., 1994)

Table 4-3

Pumping Test Results

Omega Chemical Superfund Site

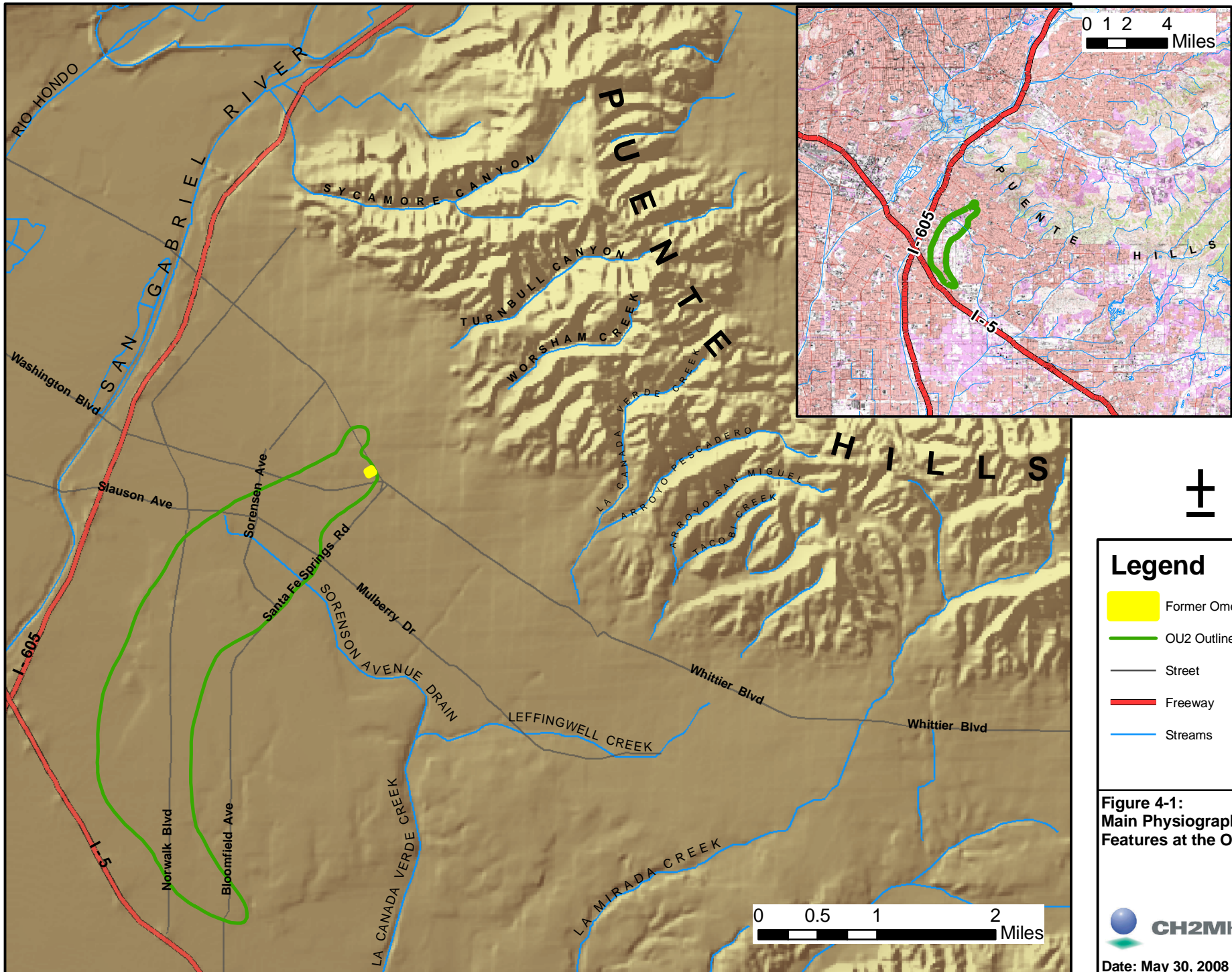
Well	K_r (ft/min)	K_{rs} (ft/min)	C (min ² /ft ⁵)	S_s (ft ⁻¹)	R^2	specific capacity (gpm/ft drawdown)	K_r (ft/d)
MW23A	0.066	N/A	0.138	4.00E-05	0.998	5	95
MW24A	0.24	N/A	0.0395	4.00E-05	0.983	139	342
MW24C	0.18	0.0062	0.0637	4.00E-05	0.999	53	255
MW26A	0.13	N/A	0.0630	4.00E-05	0.989	104	186
MW26B	0.22	N/A	0	4.00E-05	0.922	86	316
MW27A	0.037	0.0071	0.686	4.00E-05	0.993	16	54
MW27B	0.032	N/A	0.797	4.00E-05	0.985	14	45
MW30	0.20	0.012	0	4.00E-05	0.999	81	289

Well	K_z/K_r	K_r (ft/min)	S_s (ft ⁻¹)	K_{rs} (ft/min)	C	R^2	K_r (ft/d)
EW1	0.0092	0.28	2.07E-05	3.03E-03	0.188	0.9996	404

Notes: K_r = Hydraulic Conductivity of the aquifer K_{rs} = Hydraulic Conductivity of well skin C = well loss coefficient S_s = Specific Storage K_z/K_r = anisotropy ratio where z is vertical and r is horizontalN/A = Not considered in the model (meaning $K_{rs} = K_r$).

gpm = gallons per minute


 R^2 = Pearson product moment correlation coefficient squared (computed for model fit and data). S_s was held constant for monitoring well pumping test analyses at 4.0E-05 K_z/K_r was held constant for monitoring well pumping test analyses at 0.1



Legend

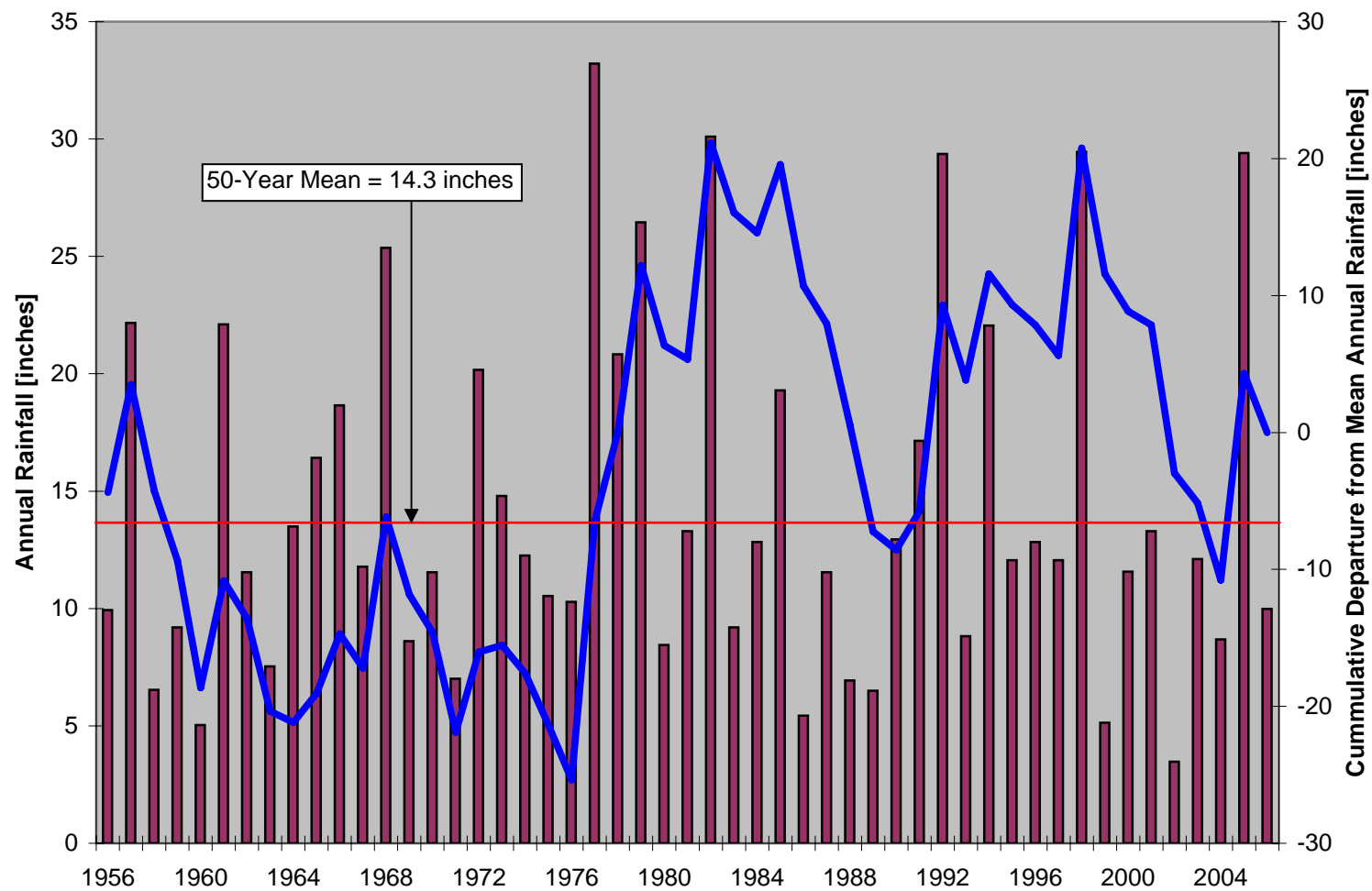
- Former Omega Facility
- OU2 Outline
- Street
- Freeway
- Streams

**Figure 4-1:
Main Physiographic
Features at the OU2 Area**

 **CH2MHILL**

Date: May 30, 2008

Figure 4-2
City of Whittier Annual Rainfall Totals
Omega Chemical Superfund Site



Note: Annual rainfall data from rain gage 106F - City of Whittier Storage Yard.

■ Rainfall — Cumulative Departure

SYSTEM	SERIES	FORMATION	LITHOLOGY	AQUIFER AND AQUICLUDE	MAX. THICKNESS (FEET)	PREVIOUS FORMATION NAMES*	PREVIOUS AQUIFER NAMES*	
QUATERNARY	RECENT	ACTIVE DUNE SAND		SEMIPERCHED	60	ALLUVIUM	SEMIPERCHED [†]	<div>LEGEND OF LITHOLOGY</div> <div> GRAVEL AND SAND</div> <div> SAND</div> <div> SILTY OR SANDY CLAY</div> <div> CLAY OR SHALE</div>
		ALLUVIUM		BELLFLOWER AQUICLUDE	140		GASPUR [†] "50 FOOT GRAVEL"	
	UPPER PLEISTOCENE	OLDER DUNE SAND		GASPUR BALLONA SEMIPERCHED BELLFLOWER AQUICLUDE	120 40 200	TERRACE COVER	SEMIPERCHED [†]	
		LAKEWOOD FORMATION		EXPOSITION ARTESIA	140	PALOS VERDES SAND		
				GARDENA	160	UNNAMED UPPER PLEISTOCENE	GARDENA [†]	
				GAGE	160		"200 FOOT SAND"	
			UNCONFORMITY		LOCAL UNCONFORMITY			
	LOWER PLEISTOCENE	SAN PEDRO FORMATION		HOLLYDALE	100	SAN		
				JEFFERSON	140			
				LYNWOOD	200		"400 FOOT GRAVEL" [†]	
				SILVERADO	500	PEDRO FORMATION	SILVERADO [†]	
				SUNNYSIDE	500			
UNCONFORMITY			UNCONFORMITY					
TERTIARY	UPPER PLIOCENE	PICO FORMATION		UNDIFFERENTIATED		PICO FORMATION		<div>*DESIGNATIONS AND TERMS UTILIZED IN "REPORT OF REFEREE" DATED JUNE 1952 PREPARED BY THE STATE ENGINEER COVERING THE WEST COAST BASIN</div> <div>[†]DESIGNATED AS "WATER BEARING ZONES" IN ABOVE NOTED REPORT OF REFEREE</div>

Figure 4-4
Generalized Stratigraphic Column
Coastal Plain of Los Angeles County
Omega Chemical Superfund Site

CH2MHILL



Legend

— Norwalk Fault

— Approximate Extent of the

— La Habra Piedmont Slope

— Limit of Operable Unit 2

— Contour (Interval 40 meters)

— Former Omega Facility

— Pleistocene alluvium

— Holocene alluvium

— Gaspar Aquifer

Tf = Fernando Formation (Pliocene)

l = Lower Member; c = conglomerate/silty sandstone

Tpsc = Sycamore Canyon Member, Puente Formation (Miocene).

Sandstone/conglomerate.

Qw = Active channel and wash deposits (late Holocene)

Qyf = Young alluvial fan and valley deposits (Holocene and Pleistocene)

a = sand, s = silt, c = clay

Qof = Old alluvial fan and valley deposits (Pleistocene)

a = sand, s = silt, c = clay



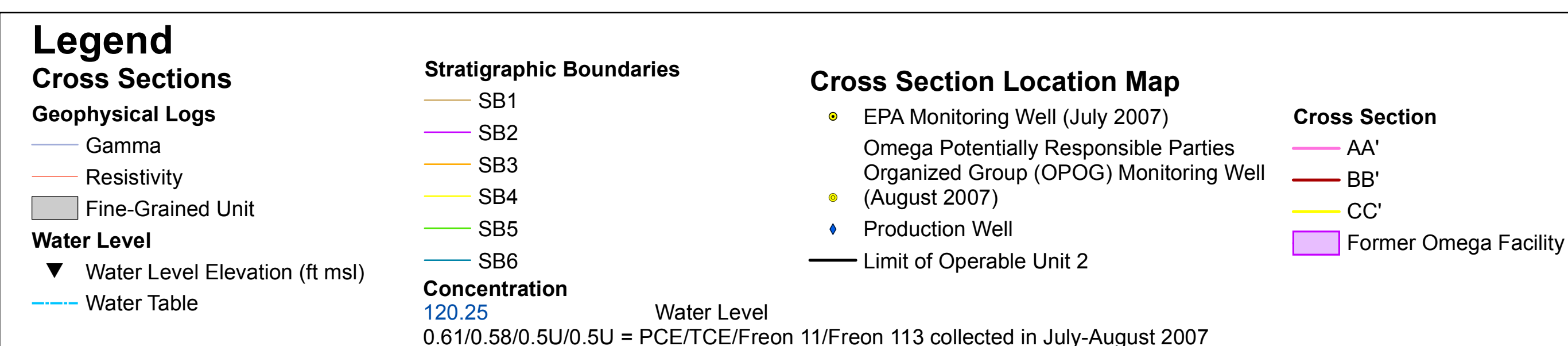
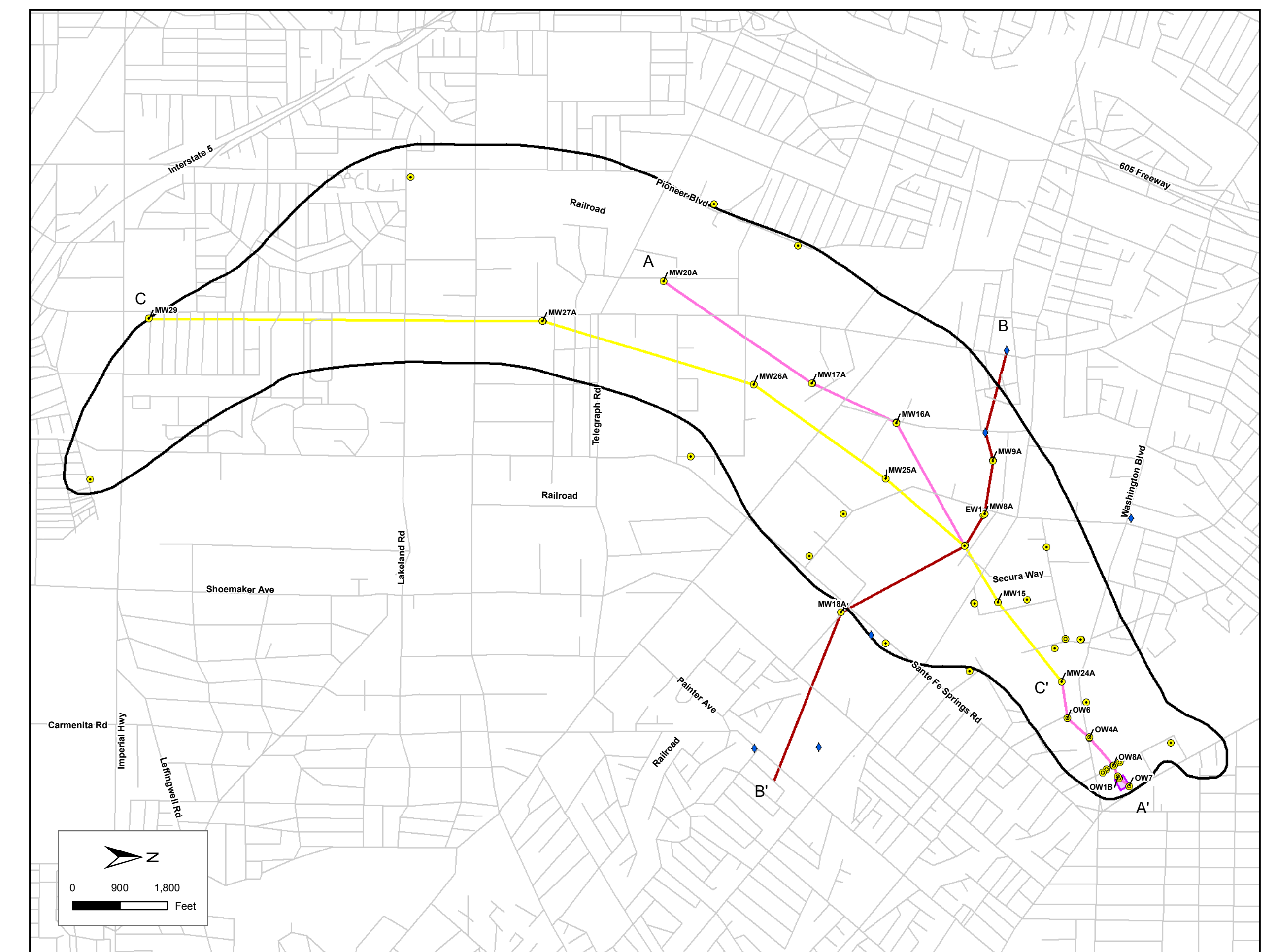
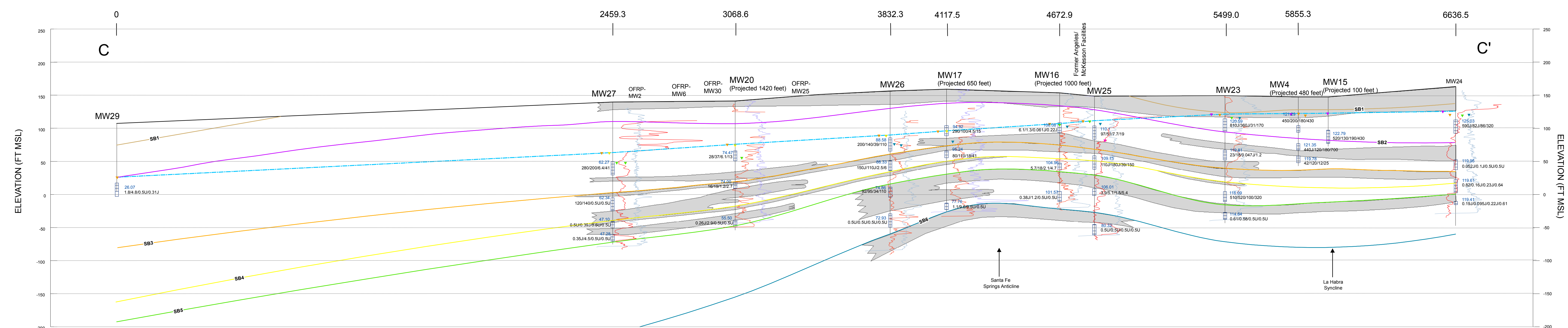
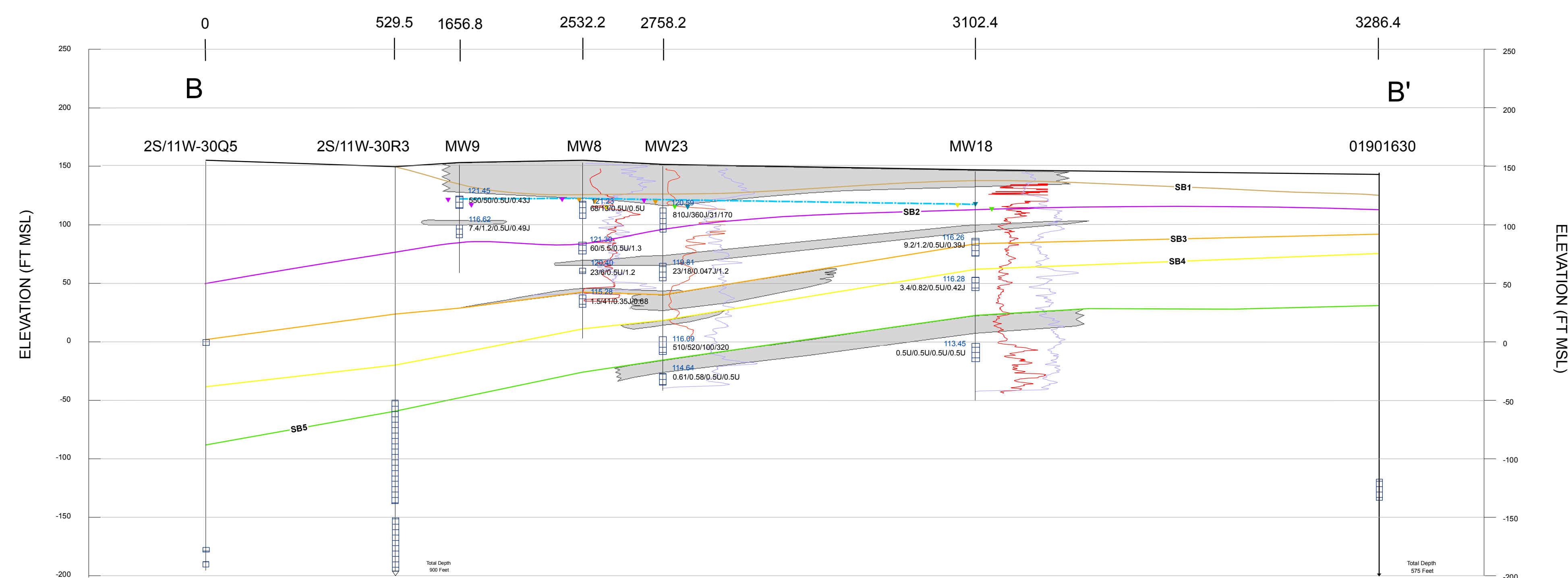
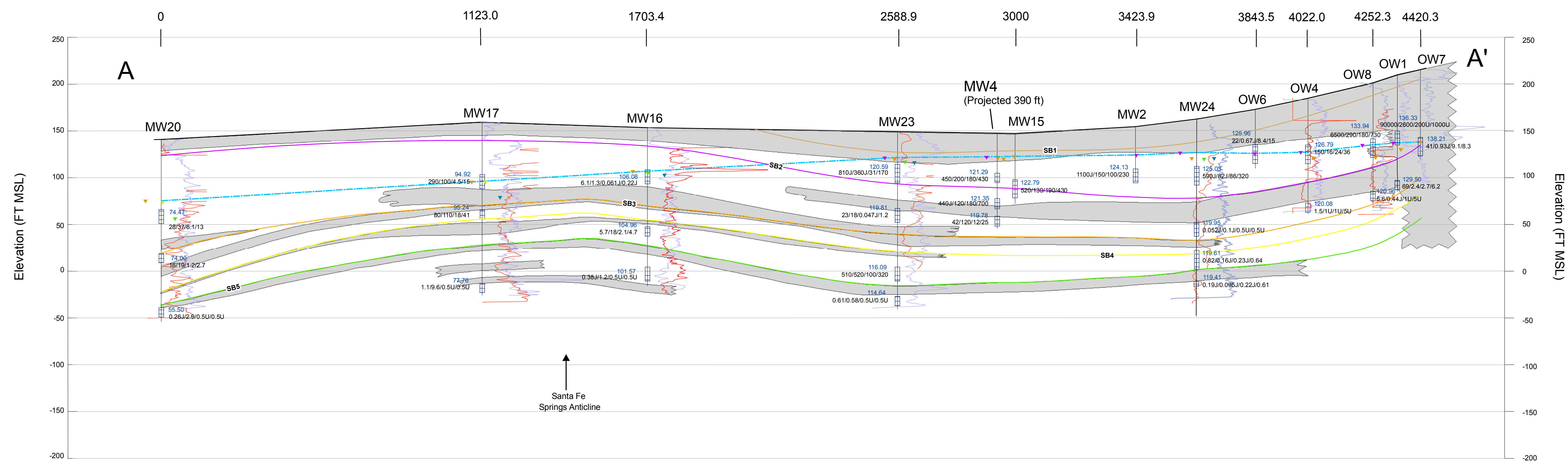
0 1 Mile

Figure 4-5
Main Geologic Features
Omega Chemical Superfund Site

CH2M HILL

Date: 5/30/2008

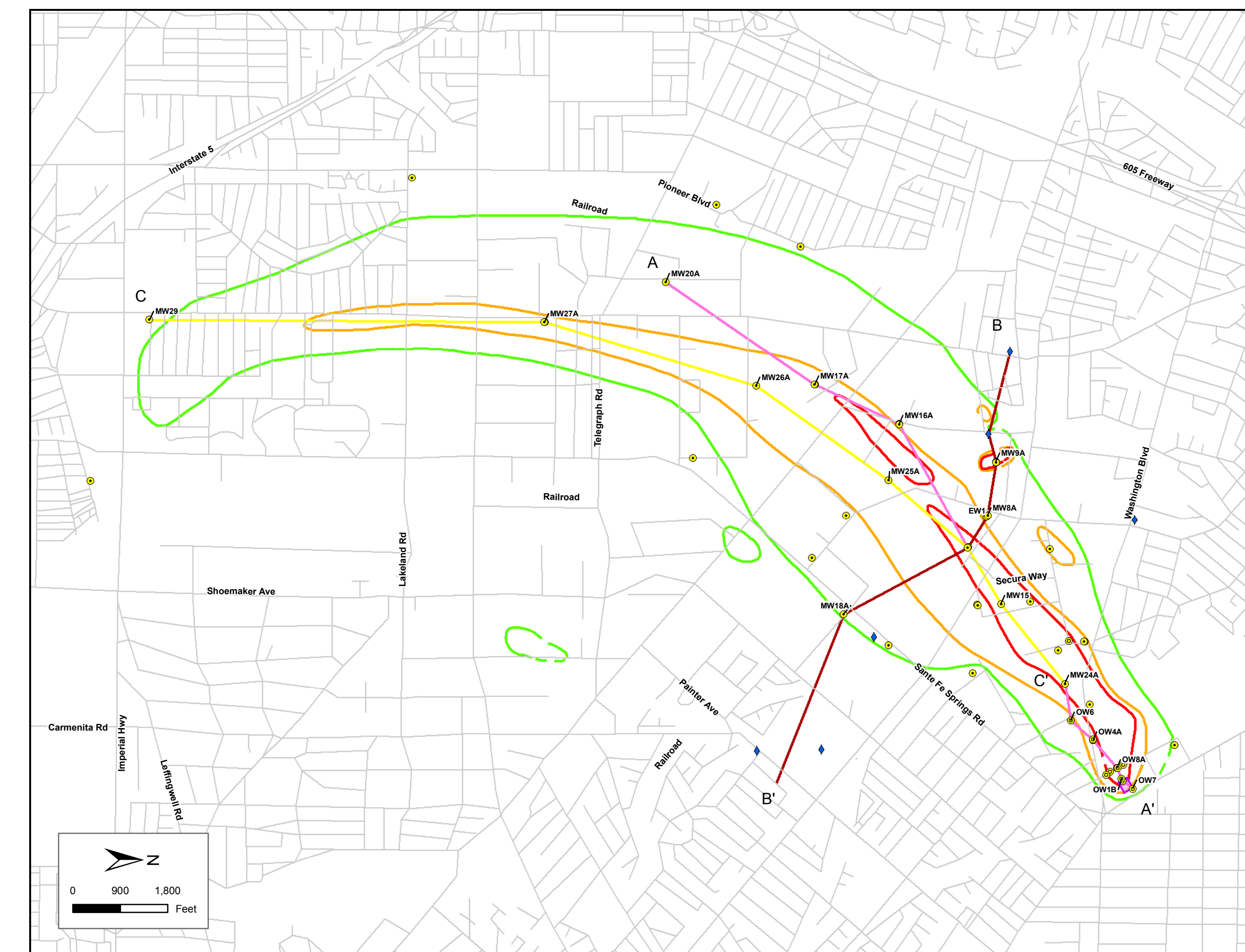
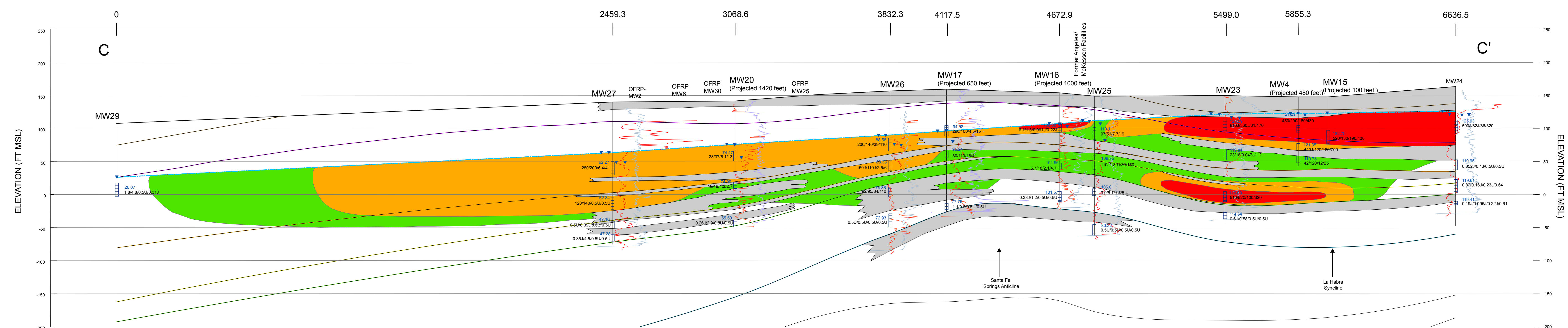
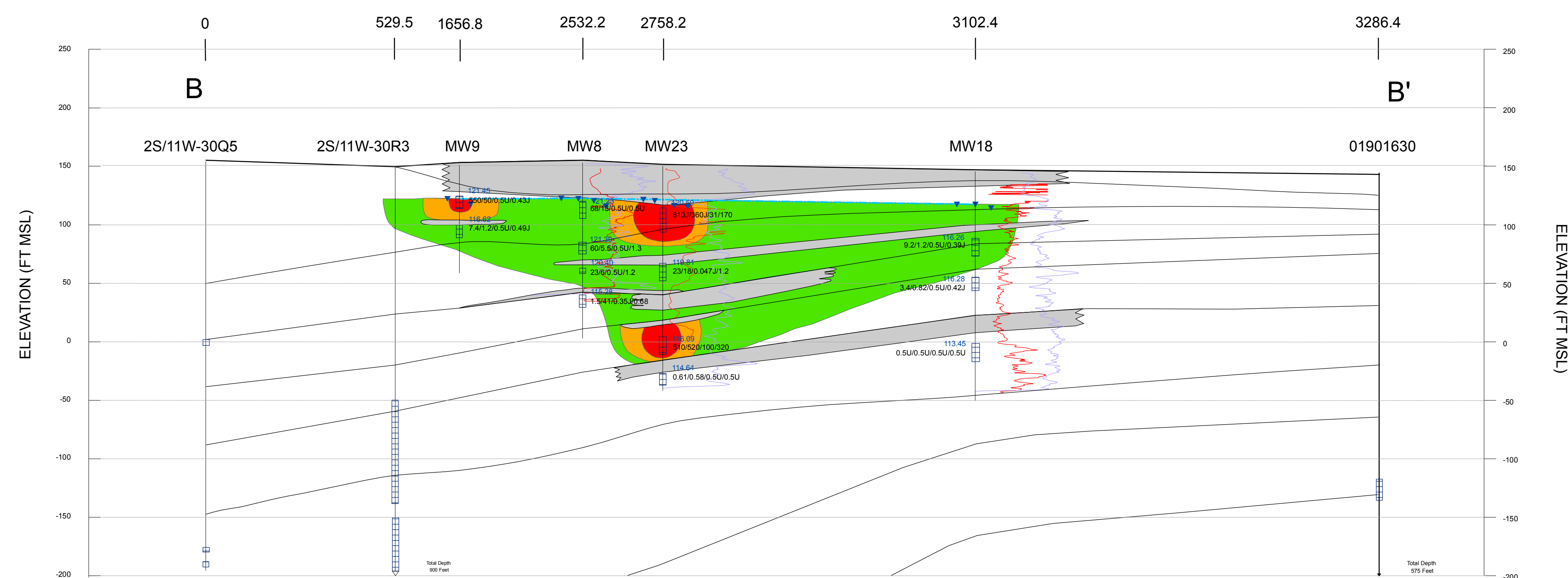
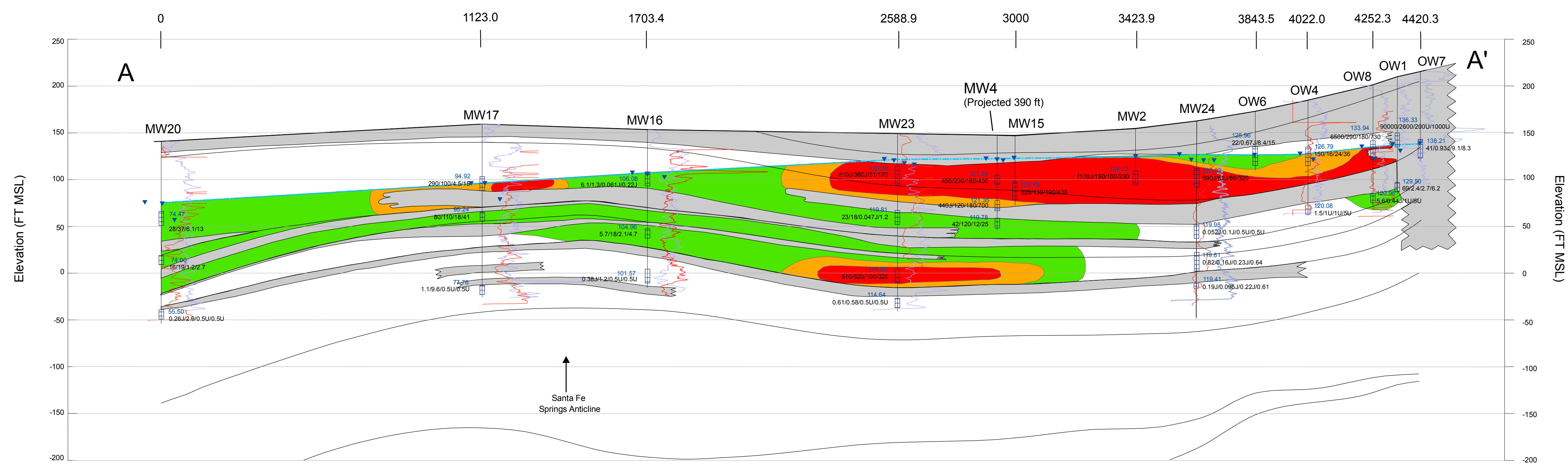
Notes: Geologic features are from Saucedo et al., 2003; Norwalk Fault location is from Reichard et al., 2003; Gaspar aquifer extent is from CDWR, 1961
\\galt\proj\Omega\2007\MapFiles\8_5x11_GeologicFeat_v1.mxd



Notes:

- 1) PCE = Tetrachloroethene
- 2) TCE = Trichloroethene
- 3) F11 = Freon 11
- 4) F113 = Freon 113
- 5) U = Non-Detect; J = Estimated Value; R = Rejected Value
- 6) SB = Stratigraphic Boundary
- 7) FT MSL = Feet Above Mean Sea Level
- 8) Colors of the water level elevations indicate above which stratigraphic boundary the well is screened
- 9) Smooth (finger-like) lateral termination of fine-grained units represents facies change into coarse-grained material. Jagged termination is used when extent is unknown.
- 10) Stratigraphic interpretation is also based on deep seismic reflection data (not shown)

Figure 4-7
Stratigraphic Sections
with Location Map
Omega Chemical Superfund Site



Legend

Cross Sections

Geophysical Logs

Gamma

Resistivity

Fine-Grained Unit

Water Level

Water Level Elevation (ft msl)

Water Table

Stratigraphic Boundaries

Composite PCE Distribution

> 5 ug/L

> 100 ug/L

> 500 ug/L

Cross Section Location Map

EPA Monitoring Well (July 2007)

Omega Potentially Responsible Parties

Organized Group (OPOG) Monitoring Well

(August 2007)

Production Well

Cross Section

AA'

BB'

CC'

Composite PCE Plume Extent

5 ug/L (Dashed where Approximate)

100 ug/L (Dashed where Approximate)

500 ug/L (Dashed where Approximate)

Former Omega Facility

Notes:
1) PCE = Tetrachloroethene
2) TCE = Trichloroethene
3) F11 = Freon 11
4) F113 = Freon 113
5) U = Non-Detect, J = Estimated Value; R = Rejected Value
6) SB = Stratigraphic Boundary
7) FT MSL = Feet Above Mean Sea Level
8) Smooth (finger-like) lateral termination of fine-grained units represents facies change into coarse-grained material. Jagged termination is used when extent is unknown.
9) Stratigraphic interpretation is also based on deep seismic reflection data (not shown)




Concentration
120.25
0.61/0.58/0.5U/0.5U = PCE/TCE/Freon 11/Freon 113 collected in July-August 2007

Figure 4-8
Hydrogeologic Cross Sections
with Location Map
Omega Chemical Superfund Site



Aerial Date: March 2004, USGS

Legend

-  Operable Unit 1
-  Operable Unit 2
-  Former Omega Facility



0 1,600 3,200 Feet

Figure 4-9
Locations of Historical Water
Production Wells
Omega Chemical Superfund Site



Date: August 1, 2008

Reference: USGS, 1905, Water-Supply Paper No. 138, Plate 3.
\\galt\proj\Omegamega\2007\MapFiles\11x17_OperableLoc_1905_v1.mxd



Aerial Date: March 2004, USGS

Legend

- California Oil and Gas Wells
- California Oil Fields
- Operable Unit 1
- Operable Unit 2
- Former Omega Facility

Reference: The California Department of Conservation, Division of Oil and Gas
(Website, <http://gis.ca.gov/catalog/BrowseCatalog.epl?id=1064>)

SCO \GALT\PROJ\OMEGA\2007\MAPFILES\11x17_CAGASWELLS.MXD

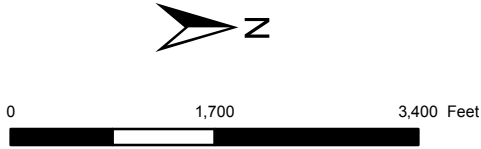


Figure 4-10
Santa Fe Springs Oil Field
Omega Chemical Superfund Site



Date: May 30, 2008